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## MASSACHUSETTS SPECIES OF HELVELLA

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(WITH PLATES 11 AND 12)

### INTRODUCTION

*Helvella* is a small genus containing less than fifty species, only a small part of which occur in any one locality. They are not so common in New England but that the fungus hunter experiences a thrill of pleasure on finding one and the day is considered eminently successful if he has picked up more than two or three species. In view of the small number of known species he anticipates no great difficulty or labor in identifying his collections, but soon finds himself confronted with these discouraging conditions: (1) there is no one place where the descriptions of the known American species are brought together, (2) there is not even a list of the species which occur in America later than that of Underwood (1896) and he gives no keys, descriptions, or figures, (3) the heterogeneous lists scattered through Saccardo's *Sylloge Fungorum* include many species which have been removed from the genus, many others known to be synonyms; the descriptions are very brief and many of them unsatisfactory even to one quite familiar with the Latin tongue, (4) there is marked confusion in regard both to the delimitation of the genus and more especially of the species, (5) the literature is scattered, contradictory, and much of it not readily accessible, (6) lists other than those of Saccardo are only local, (7) *exsiccati* speci-

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mens are of little value in identification because most of the specific characters are lost in the process of drying.

There is real need of a comprehensive monograph of all the North American forms. The writers have neither time nor means at present to treat the subject so broadly, but as a contribution toward the accomplishment of such a work they have made a study of the species which occur in their state, the results of which are set forth in this paper. They have, however, included not only the species which they and others have collected in Massachusetts, but also have added in the key and descriptions all other species which have been reported from the northeastern states, in order that the paper might be more widely useful and also because species which occur in neighboring states may be looked for in Massachusetts, although they have never been reported.

Species of *Helvella* are separated from each other largely on the bases of the shape, configuration, size, and color of the stipe and pileus. The spores, asci, paraphyses, and internal structure of ascomata of all the species which occur here are so nearly identical that microscopic examination of dried specimens is useless. Also, when a plant is dried, especially if pressed, it loses its shape and original size and the colors almost always change. The most valuable contribution one can make to the understanding of the species of the genus is not by making numerous collections which are filed away to receive later worthless descriptions of what they look like in the dried state and measurements of spores, etc., which are all alike. Much more valuable are careful notes, descriptions, photographs and drawings of fresh plants. Commenting on the unsatisfactory nature of dried specimens, Bresadola has well remarked that "he alone acquires a correct knowledge of these species who is able to spend the green season of the year in regions where they grow abundantly and to make comparisons between them" (Fung. Trident. p. 64. Translated). In making notes on the collections, one should describe colors by well-known color standard charts; popular descriptions of colors and shades of colors are subject to rather wide ranges of interpretation. Colored plates such as those of Boudier are especially useful.

The distinct species which occur here are comparatively few but the names which have been applied to them are numerous, confusing, and discouraging. In the present paper the writers have attempted (1) to determine according to the international rules of nomenclature what are the correct names for the species which occur here, (2) to indicate which other names are synonyms and which names apply to species which are no longer considered as belonging to this genus, (3) to present a key by which any specimen can be quickly placed in its proper species, (4) to bring together in one place the original descriptions of all of our species (or Fries' description if described before 1823), (5) to give for each species a full but concise English description, based on study of fresh specimens and study of all available literature, (6) to publish photographs of all species of which fresh specimens from which to make them have been obtained.

In addition to our own collections and exsiccata in the herbarium of the Massachusetts Agricultural College, the herbaria of Harvard University, Boston Mycological Club, New York Botanical Garden, and New York State Museum at Albany have been examined.<sup>1</sup> All the literature bearing on the genus, both European and American, has been carefully read.

#### LITERATURE OF THE GENUS

Linnaeus has commonly been cited as authority for the genus name *Helvella*. He first used it in its present form in the second edition of *Species Plantarum* (1763). In the ninth edition of his *Genera Plantarum*, however, Gleditsch (1753) is cited as the authority for the genus name. Gleditsch, however, in his *Methodus Fungorum*, called it *Elvela* and included under it various species which we now place in the *Helvellales* and *Pezizales*, Jew's ear fungus and many other foreign species, using the polynomial system of nomenclature. This use of the name to

<sup>1</sup> The writers are greatly indebted to Dr. R. Thaxter, of Harvard University, Dr. F. J. Seaver, of the New York Botanical Garden, Miss Jennie F. Conant, of the Boston Mycological Club, and to Dr. H. D. House, New York State Botanist, for the privilege of examining the herbaria under their care, and for many other courtesies and assistance. Dr. Seaver also kindly read the manuscript.

include a large part of the Discomycetes and various other forms was usual before the time of Linnaeus and not uncommon for many years after him. In the first editions of *Flora Suecica* (1745), *Genera Plantarum* (1737), and *Species Plantarum* (1753) Linnaeus spelled the name *Elvela*. In the second edition of *Flora Suecica* (1755), he used *Elvella*. He offers no explanation of why he twice changed the spelling of the name nor from what source he originally took it. Phillips offers this rather unsatisfactory explanation of its origin, that it was a Latin word used by Cicero to denote some kind of fungus. The etymology of the word is uncertain. All three methods of spelling it have been used by various writers but the majority since the beginning of the last century, including Persoon and Fries have used *Helvella*. Seaver, in a recent article has returned to the original spelling *Elvela*. In the present paper the orthography of Fries is followed.

At most, we owe nothing but the name to Linnaeus; he contributed nothing to our knowledge of the species included. He united all of them under the specific name *Mitra* (except *El. Pineti*, which is not a *Helvella* at all as understood by modern mycologists). One secures more information in regard to the species of the genus from the works of previous writers than from Linnaeus. Thus Micheli in 1729 had already grouped the species of *Helvella* in much the same sense as we now know them in the section *Fungoidea fungiformia* of his genus *Fungoides*. Each of the nine species in this section is briefly described and three of them are well illustrated. Even before the time of Micheli one finds some good descriptions by Rajus (1704), Porta (1592), Clusius (1583), and others. These fungi seem to have been subjects of considerable interest to the older botanists and hence were frequently described and figured. But in this early literature one finds them not under the genus name *Helvella*, but under *Boletus*, *Phallus*, *Fungoides*, *Morchella*, *Boleto-lichen*, etc.

During the period between the appearance of Linnaeus' *Species Plantarum* and the publication of Fries' *Systema Mycologicum*, knowledge of the genus was greatly advanced by the works of



Schaeffer, Afzelius, Persoon, Scopoli, Bulliard, Sowerby, and others who made smaller contributions. But the multiplicity of publications did not result in a harmonious system of nomenclature. The changing and interchanging of names during this period is very confusing. An examination of the synonymy which is appended under some of the older species such as *H. crispa* and *H. lacunosa* gives one some idea of the state of the nomenclature at that time.

Fries, in the second volume of his *Systema Mycologicum*, treated the genus fully and very clearly, and his work furnishes an excellent basis for our present taxonomy of it. In reading this book one is surprised to find how few taxonomic changes have been made in the last century. To be sure some of the species have been transferred to *Gyromitra*, which he later (1846) split off from *Helvella*, and a few others are now believed to be among closer relations in the Pezizales, but most of his species are still in the genus *Helvella* and bear the same names which he used for them. Also, no small part of the species which have been described since then could be easily referred to species which he described.

Since his time a number of species have been described from various parts of the world by various authors. European species have been well monographed by Rehm, Massee, Gillet, Phillips, et al., excellent colored plates published by Boudier, Cooke, and others. But on turning to the American literature of the genus we find very little of value. A few new species have been described by Peck and Clements—some few of which are really new, others probably merely variations of old species. Underwood published in 1896 a list of all species which had been reported from North America. A few local lists, sometimes accompanied by descriptions and figures, such as those of Hone (1904) and Burt (1899), complete the sum of American literature on the genus.

Turning now to the literature which deals with collections of *Helvella* within the state of Massachusetts we find that the full extent of our information is based on the inclusion of names of a few species in published local lists of fungi. The first of these

lists is Hitchcock's Catalogue of Plants Growing without Cultivation in the Vicinity of Amherst College published in 1829. In this list one finds (p. 61) three species of *Helvella*: *H. albida* Bull., *H. esculenta* Pers., and *H. mitra*? L.<sup>2</sup> The second one of these species is now *Gyromitra esculenta* Fr. and need not be considered here. The other two are somewhat difficult to place exactly. There is a *H. albida* Pers. (= *H. elastica* Fr.) and a *H. albida* Schaeff. (= *H. crispa* Fr.), but there seems to be no *H. albida* Bull. His third species is still more indefinite in view of the fact that Linnaeus included all the species of *Helvella* under the name *H. Mitra*. Hitchcock's list then adds little or nothing to our knowledge of what species of *Helvella* occurred in the state at that time. Charles L. Andrews presented a paper before the Boston Society of Natural History in 1856 on the fleshy fungi of Massachusetts. He included descriptions of 36 species but no *Helvellae* were mentioned. During the same year C. J. Sprague read a paper before the society, "Contributions to New England Mycology," and a second paper under the same title two years later. In his first paper he included 350 species of fungi, most, but not all, of which were collected about Boston. He mentions in this paper *Helvella* (*Peziza*) *macropus* Pers. and *Helvella lacunosa* Afz., the latter however having been collected in Maine. In his second paper he increased the number of reported fungi to 678. *Helvella crispa* Scop. and *H. Monachella* Fr. are in the second paper and one judges from the context that they were collected within the state. In 1860 Sprague gave up his study of fungi and turned over his unworked material to C. C. Frost who, in 1869, presented a list, "Further Enumeration of New England Fungi," of 262 species not mentioned in Sprague's lists. The only *Helvella* mentioned is *H. ephippium* Lev. which may or may not have been collected within the state. In 1875, Tuckerman and Frost's "Catalogue of Plants Growing without Cultivation within Thirty Miles of Amherst College" appeared. In the list of fungi, Frost included four species of *Helvella*: *H. crispa* Fr., *H. elastica* Bull., *H. lacunosa*

<sup>2</sup> The same list is repeated in his Report on the Geology, Botany and Zoölogy of Massachusetts (1833) and in his Catalogues of the Animals and Plants of Massachusetts (1835).

Afz., and *H. ephippium* Lev. It has been customary for mycological writers to speak of Frost's collections as being from Massachusetts. Frost, however, did not live in Massachusetts and most of his collections were made near his home in Brattleboro, Vt. In the first and second volumes of the bulletins of the Bussey Institute 1875-1900, Farlow published two long lists of fungi found in the vicinity of Boston. In these lists however, no species of *Helvella* were mentioned unless we wish to consider *Peziza macropus* Pers. as a *Helvella*. Underwood, in his paper "On the Distribution of the North American *Helvellales*" adds nothing to the above list except the interesting fact that he himself had collected *H. elastica* in this state. In the Peabody Museum at Salem, Massachusetts, there are a large number of water-color drawings of fungi by George E. Morris of Waltham, Mass. The locality of collection is indicated under each drawing. The species of *Helvella* which he illustrated from collections in this state were: *H. crispa*, *H. ephippium*, *H. lacunosa*, *H. Monachella*, *H. macropus*, and *H. macropus* var. *brevis* Pk. The last named variety was described by Peck (Bul. Tor. Club 29: 74) from specimens sent to him by Morris.

### SYSTEMATIC ACCOUNT

*HELVELLA* Fr. Sys. Myc. 2: 13. 1823

*Boleto-lichen* Jus. Mem. Ac. Sc. Paris. 1728, p. 268.

*Fungoides*, Sect. *Fungoidea fungiformia* Mich. N. Pl. Gen. p. 204. 1729.

*Elvela* L. Gen. Pl. (Ed. I), p. 327. 1737.

*Elvela* L. Sp. pl. (Ed. I), p. 1180. 1753.

*Elvela* Gled. (pars). Meth. fung., p. 36. 1753.

*Elvella* L. Fl. suec. (Ed. II), p. 456. 1755.

*Boletus* Batt. (pars). Fung. arim. hist., p. 23. 1759.

*Helvella* L. Sp. pl. (Ed. II), p. 1649. 1763.

*Phallus* Scop. (pars). Fl. Carn. 2: 473. 1772.

*Leptopodia* Boud. Bul. Soc. Myc. Fr. 1: 99. 1885.

*Fries' description of the genus.* Receptaculum pileatum, centro suffultum, deflexum, subinflatum, sinuosum, subtus concavum sterile, supra margineque hymenio tectum. Hymenium laeve,

persistens. Asci fixi.—Stipes constanter praesens, cum centro receptaculi contiguus, cavus l. medulla floccosa farctus. Pileus adultus mitraeformis, compressus, lobatus, siccus, subtus pruinosis. Substantia ceraceo-membranacea.

Plants large, usually several centimeters high, stipitate and upright. Pileus thin, deflexed, attached at the center, concave below; of irregular shapes, lobed, irregularly undulate, mitriform, compressed, saddle-shaped, etc.; not typically cup-shaped or closed when young; without gyrose elevations on the upper surface; margin free or attached to the stipe on opposite sides or at several points; of a waxy membranaceous or waxy-fleshy consistency; upper surface covered by the hymenium, glabrous; lower surface sterile, glabrous, pruinose, tomentose or villose, sometimes rugulose or venose. Hypothecium and excipulum of densely interwoven hyphae passing outwardly into a pseudoparenchymatous cortex of larger cells. Stipe slender or stout; straight or irregularly undulate; smooth, lacunose or with deep longitudinal furrows separated by narrow costae, frequently entire stipe composed of costae united by their inner edges, outer edges of costae usually irregularly anastomosing; solid, stuffed or hollow; glabrous, pruinose, tomentose or villose. Asci long cylindrical or narrowly clavate, with 8 spores in a single row. Spores hyaline, continuous, ellipsoidal, smooth,  $15-20 \times 9-12\mu$  in our species, with a large prominent central oil globule. Paraphyses slender, straight, septate, sometimes branching, enlarging upward to 2-3 times the diameter of the base, hyaline or tinged with brown.

Solitary or gregarious, subfleshy fungi, without distinctive taste or odor, autumnal, in the damp woods on the ground or wet rotten stumps or logs. Most of them are said to be edible.

The genus as originally delimited by Fries (1823) falls naturally into three sections, as follows:

Stipe longitudinally sulcate-costate (fluted).	<i>Helvella</i> proper
Stipe smooth, or at most somewhat lacunose or irregular.	
Small plants with slender stipes.	<i>Leptopodia</i> Boud.
Large plants with thick stipes.	<i>Gyromitra</i> Fries

The first section is the oldest and best known and is typified by the common species *H. crispa* and *H. lacunosa*. These species have never been referred to any other genus since the time of Fries.

The second section includes *H. elastica*, *H. atra*, *H. ephippium* and *H. adhaerens*. It includes the species on the doubtful line

between *Helvella* and *Macropodia*. Boudier (1885) separated these species from *Helvella* and established the genus *Leptopodia* with *H. elastica* as the type.

The third section includes *H. esculenta*, *H. infula*, and other species which are now commonly referred to the genus *Gyromitra*. Their characters tend toward those of *Morchella*. Fries considered *H. esculenta* so distinct from the other species that he made it the basis of a separate genus *Gyromitra* which he characterized thus: "*Discus bullato-inflatus, costis elevatis gyrosus*" (Sum. veg. Scan. 346. 1846). He left *H. infula*, however, in the genus *Helvella*. This species seems more closely related to *H. esculenta* than to the other *Helvellae*, and Rehm has therefore removed it also to *Gyromitra*. Seaver considers it identical with *G. esculenta* and unites the two under the name *Elvela infula* Schaeff. Pending further study of fresh material in the field, the writers have not considered this or other species of *Gyromitra* in this paper. *G. brunnea* Und. is the only other species of that genus which they have found in Massachusetts. They hope to discuss *Gyromitra* in a future paper.

#### KEY TO SPECIES OF HELVELLA IN THE NORTHEASTERN STATES

##### I. Stipe longitudinally sulcate-costate (fluted).

1. Plants light-colored (white, cream-colored to light-buff, or with bright-yellow hymenial surface), margin upturned, usually free. *H. crispa*.
1. Plants some shade of gray, brown or black.
  2. Pileus venose below with prominent branching veins radiating from the stipe. *H. Queletiana*.
  2. Pileus not prominently venose below.
    3. Pileus more or less saddle-shaped, compressed, firm, margin permanently adnate with the stipe. *H. lacunosa*
    3. Pileus irregularly agariciform (only rarely saddle-shaped), less firm, margin usually found free. *H. palustris*.
    3. Pileus cup-shaped (pezizoid), stipe and lower surface of pileus black velvety. *H. nigra*

##### II. Stipe smooth; somewhat lacunose at times but never sulcate-costate.

1. Margin of pileus always free.
  2. Pileus more or less cup-shaped (margin upturned), lower surface and stipe villose with brown moniliform hairs.
    3. Spores blunt-ellipsoid, 15-18 $\mu$  long. *H. ephippium*.
    3. Spores ellipsoid-fusiform, 18-25 $\mu$  long. *Macropodia macropus*

2. Pileus not cup-shaped, stipe white or very light-colored, not villose. *H. elastica.*
1. Margin of pileus adnate with stipe.
  2. Entire plant whitish or smoky-white (may become brown in age or in drying). *H. adhaerens.*
  2. Smoke-gray to fuscous-black, stipe very dark. *H. atra.*
  2. Pileus brown, stipe white. Larger than the two preceding species. *H. Monachella (?)*

I. *HELVELLA CRISPA* Fr. Sys. Myc. 2: 14. 1823

*Elvella pallida* Schaeff. Fung. 3: t. 282. 1770.

*Phallus crispus* Scop. Fl. Carn. 2: 475. 1772.

*Phallus lobatus* Batsch. Elenchus fung. p. 129. 1783.

*H. lacunosa* var. *pallida* Afz. Kongl. Vet.-Akad. nya Handl. 4: 303. 1783.

*H. alba* Berg. Phyt. i. t. 145.

*H. nivea* Schrad. Journ. Bot. 2: 66.

*H. mitra* var. *alba* Bull. Champ. p. 298. 1786.

*H. mitra* var. *fulva* Bull. Champ. p. 298. t. 466. 1789.

*H. mitra* Sow. Col. Fig. Brit. Fung. t. 39. 1797.

*H. leucophaea* Pers. Obs. Myc. 2: 19. 1799.

*H. leucophaea* Tratt. Ess. Schw., p. 163. 1809.

*Fries' description.* Pileo deflexo lobato liberato crispo pallido, stipite fistuloso costato-lacunoso.

Solitaria, magna, 3-5 unc. alta, primo obtutu glabra. Stipes niveus exsiccatione flavescens, validus, deorsum ventricosus, totus sulcato-costatus lacunosusque, costis planis fistulosis, unde stipes dissectus e tubulis pluribus discretis componitur. Pileus deflexus, inflatus lobatus, margine primo stipiti adnato, mox libero undulato laciniato-contorto & crispato.

Pileus drooping, lobed, irregularly wrinkled and contorted above, margin at first slightly adnate to the stipe but soon free, extreme margin curled upward in all of our specimens, fragile and easily splitting, white, cream color, light-buff or yellow, 1.5-7 cm. in diameter, glabrous, smooth or sometimes rugulose beneath. Stipe stout, glabrous or pruinose, white or colored like pileus, ventricose toward the base and attenuate upward, longitudinally sulcate-costate, lacunose by the irregular anastomosing of the outer margins of the costae, whole stipe apparently formed by the edgewise anastomosing of flat plates enclosing tubes in the center and furrows on the surface, 2-10 cm. tall, .8-2 cm.

diam. Asci cylindrical,  $250-300 \times 15-18\mu$ . Spores ellipsoidal, smooth, hyaline, with large central oil drop,  $16-19 \times 9-12\mu$ . Paraphyses straight, slender, enlarging upward, hyaline, slightly longer than the asci. (Pl. II, fig. I.)

Plants usually solitary, in dense wet woods, especially along streams, on the ground, leaf-mold, or sometimes decayed logs or stumps. Common in autumn.

The pilei of all the specimens which the writers have collected about Amherst are cream-color, light-buff, or warm-buff. Plants exhibiting shades of pink or red are said to be common in Europe. On the basis of color Fries (l. c.) enumerates three forms; (a) *alba*, *pallescent*, (b) *incarnata*, (c) *lutescent*. Similarly Massee (1895) gives:

"Forma *alba*. Pileus whitish.

Forma *Grevillei*. Under surface of pileus reddish; stem white.

Forma *incarnata*. Pileus and stem flesh color.

Forma *fulva*. Pileus yellowish to tawny."

In the exsiccati the stipes become light-buff or warm-buff but the hymenial surface becomes much darker, cinnamon, bay, ochraceous-tawny or ochraceous-buff in specimens we have compared with Ridgway's Color Standards.

The size of the plants is an extremely variable character; a condition which is true of all the species of *Helvella* which we have studied. Our specimens have usually been small, rarely exceeding 4-5 cm. in height, and we have frequently found diminutive forms less than 1.5 cm. high. Hone (1904) describes the Minnesota specimens as up to 10 cm. in height and the stipe up to 5 cm. in diameter. In the Harvard herbarium there are specimens which measure up to 8 cm. tall; in the fresh condition they must have been fully as large as those from Minnesota. Most of the specimens which one finds have the pileus entirely free on the margin. We do not find the costae hollow in our small specimens as described by Fries and others.

*Massachusetts Collections*: Boston 1858 (Sprague); Waltham, Oct. 1901 (Morris); Roslindale, Oct. 1901 (W. R. Hudson), Bost. Myc. Herb.; Williamstown, Sept. 1901 (Farlow), in Harv. Herb.; Amherst, Sept. and Oct. 1919 and 1920 (Ickis & Anderson) M. A. C. Herb. 2643, 2715, 2732, 2822. Frost's col-

lections are not listed here or later because of the uncertainty of the locality. The number of exsiccati in the various herbaria indicate that this species is common throughout the eastern states.

2. *HELVELLA LACUNOSA* Fr. Sys. Myc. 2: 15. 1823

*Boletus leucophaeus* Batt. Arim. hist., p. 25. 1755.

*Elvela Mitra* Schaeff. Fung. t. 154. 1763.

*Elvela monacella* Schaeff. Fung. t. 162. Index, p. 106. 1763.

*Helvella lacunosa* Afz. Kong. Vet.-Akad. Handl. 4: 303. 1783.

*H. sulcata* Afz. Kongl. Vet.-Ak. Handl. 4: 305. 1783.

*H. sulcata* Willd. Fungi. berolin., p. 398. 1787.

*H. sulcata* Fr. Sys. Myc. 2: 15. 1823.

*H. sulcata* Afz. var. *cinerea* Bres. Fung. Trid., p. 41. 1881.

*H. sulcata* Afz. var. *minor* Clem. Bot. Sur. Nebr. 4: 8. 1896.

*Fries' description.* *H. lacunosa*, pileo inflato lobato cinereo-nigro, lobis deflexis adnatis, stipite fistuloso costato-lacunoso. Ab antecedente (*H. crispa*), pro cuius varietate facile sumi posset, differet pileo magis regulari, 2-4-lobo, vix laciniato, lobis serius liberatis & praecipue colore. Statura plerumque minor, subinde tamen aequae procera occurrit s. *Helvella mitra* g. *pratensis* Alb. & Schwein. consp. p. 298. Quamvis igitur characteres acuti desint, in natura constans; etiam in cibariis vilior.

*H. sulcata*, pileo deflexo lobato adnato, stipite farcto costis aequalibus sulcat. Solitaria, raro gregaria, tota glabra, certe a priori diversa. Stipes farctus, 2 unc. longus, 4-5 lin. crassus, teres, sursum attenuatus, sulcis longitudinalibus profundis ex-artus, costis tenuibus solodis, nec lacunoso-fistulosis ut in praecedentibus. Pileus deflexus aequaliter 2-3-lobus, compressus, laevis, exsiccatus obscurior, latere interiori stipiti adnatus.

Pileus lobed, saddle-shaped, compressed or irregular, lobes deflexed and adnate with the stipe, firm, varying in color from smoke-gray to almost black, 1.5-5 cm. broad, glabrous, smooth, or lower surface rugulose. Stipe even or attenuate upward or downward, sometimes ventricose, smoke-gray, sulcate-costate, with the costae sometimes anastomosing by their outer margins, sometimes free throughout the extent of the stipe, costae solid in our specimens but said to be sometimes hollow, stipe formed as in *H. crispa*, 1.5-10 cm. in height by 0.5-2 cm. in diameter. Asci cylindrical, 250-350  $\times$  15-20 $\mu$ . Spores ellipsoidal, hyaline, smooth, with large central oil drop and some very much smaller ones, 15-19  $\times$  10-12 $\mu$ . Paraphyses slender, septate, enlarging upward, hyaline or brown tinted. (*Pl. II, figs. 2, 3, 4, 5.*)



Solitary or gregarious, on the ground, or frequently on wet, rotten logs and stumps in the woods. Not uncommon in autumn.

This species varies greatly in size, shape, and color with the locality and conditions of development. Such variations have resulted in the establishment of a number of species and varieties, as indicated by the synonyms listed above, but the lack of good constant specific characters and the occurrence of intergrading specimens indicate that they might better be considered merely as variable forms of this rather broad species. The writers have followed Rehm (1896), Massee (1895), and others in uniting *H. sulcata* Afz. with this species. Fries considers them as separate species and places in *H. sulcata* the forms with stuffed stipes and solid costae which do not anastomose, while in *H. lacunosa* he places those with hollow stipes and hollow costae which sometimes anastomose. Later writers have also found that the latter is the larger species, e.g., Boudier (1905) gives the height of *H. lacunosa* as 5-12 cm. and that of *H. sulcata* as 3-7 cm., also adding that the stipe of *H. sulcata* is not ventricose at the base and the spores are a little smaller. Specimens collected about Amherst have rarely been over 5-6 cm. in height, the costae are solid and the stipes not hollow. They agree, therefore, more nearly with the descriptions of *H. sulcata*. But in the anastomosing of the costae they resemble *H. lacunosa* Fr. In view of the pronounced tendency to variation in stature which is exhibited by various species of *Helvella*, size, unless very extreme, would hardly seem to be a safe specific character. As for the distinction based on the solid or hollow condition of the costae, we have previously noted that both conditions seem to exist in *H. crispa* but no writer has attempted to split the latter into two species on this basis. In our specimens interior tubes have been found only where the furrows on the surface have been converted into tubes by the anastomosing of the outer edges of the costae.

Our specimens have uniformly had smoke-gray stipes and smoke-gray to fuscous pilei, which become darker as they become older or dry out. Fries lists under *H. lacunosa* a form *major* with white stipe and form *minor* with blackish stipe. Also

under *H. sulcata*, he has form *fusca* with black pileus, brown stipe becoming ash-gray on drying and form *cinerea* which is entirely ash-gray. Boudier describes *H. lacunosa* as having the pileus black both above and below and the stipe somewhat lighter, while in *H. sulcata* it is blackish or cinereous with a paler stipe. Willdenow mentions a variety of *H. sulcata* which is entirely white. One concludes after reading the descriptions of the various authors that the shade of color is extremely variable but it is agreed by all that it can be readily distinguished from *H. crispa* by its sombre hues. Also in this species we do not find the margin curled upward as in *H. crispa*, and in our collections the pileus has never been found entirely free from the costae.

*Massachusetts Collections:* Sprague (1856), Frost (1875), and Underwood (1896) have included this species in their lists of New England fungi but the localities from which they were collected are uncertain. Waltham, Aug. 1898 (Morris), Bost. Myc. Herb.; Wareham, Sept. 1912 (E. C. Ellis) Bost. Myc. Herb.; Holbrook, Aug. 1899. (Alice L. Grinnell) Bost. Myc. Herb.; Manchester, Sept. 1898 (N. D. Elliott) Bost. Myc. Herb.; S. Acton, July 1918. N. Y. Bot. Gard. Herb.; Ellis, Aug. 1907 (G. E. Morris) N. Y. Bot. Gard. Herb.; Boston, July 1909 (Morris); Amherst, Oct. 1920 (Ickis & Anderson) M. A. C. Herb. It appears to be a common species in this state.

3. *HELVELLA PALUSTRIS* Pk. Ann. Rpt. N. Y. State Mus. Nat. Hist. **33**: 31. pl. 12, f. 16-18. 1880

*Peck's original description.* Pileus irregular, at first blackish and slightly adnate, then grayish brown or mouse-colored and free, rugose beneath; stem equal, slender, sulcate-costate, colored like the pileus, the costae thin, subacute; asci cylindrical; spores broadly elliptical, .00064 in. to .0008 in. long, .0005 in. broad, containing a single large nucleus; paraphyses thickened above, brown.

Plant 1 in. to 2 in. high, pileus 6 lines to 12 lines broad, stem about 2 lines thick. Among mosses and liverworts in swamps. Manlius. Aug.

This species is related to *H. sulcata*, from which it differs in its more slender and darker colored stem, its less firm and more

free pileus and its darker colored paraphyses. In the dried specimens the upper surface of the pileus has assumed a blackish color, but the lower surface has retained very nearly its normal hue. The dark colored slender stem readily separates this species from all others with costate or lacunose-costate stems.

We have found but a single specimen of this species. The entire plant was gray, the slender stipe 5 cm. high by 3 mm. thick and beautifully fluted with prominent veins which did not anastomose. The pileus was entirely free, not firm, almost smooth beneath. Spores measured  $14-18 \times 7-10\mu$  and could not be distinguished from those of other *Helvellae*. In order to clear up doubts about this species we studied carefully the specimens in Peck's herbarium at Albany. Six specimens were found but they were in imperfect condition. The place of collection was Manlius Center but no date was given (a frequent omission in the Peck herbarium) and it was of course impossible to say whether it was the type material. In the dried state the pilei were about 2 cm. in diam. and black, the stipe 4 cm. high  $\times$  3 mm. diam., sulcate costate, bistre or a little lighter upward, pileus attached in some but mostly free, finely wrinkled below. Whether or not the differences are sufficient to warrant the separation of this form from *H. lacunosa* as a distinct species is a question which can be answered only by study of more abundant fresh material. It is also very similar to *H. Queletiana*. In the absence of more abundant material for investigation we have considered it as a distinct species.

*Massachusetts Collections:* Pelham, Sept. 1917 (Anderson).

4. *HELVELLA QUELETIANA* Sacc. & Trav. Syll. Fung. 19: 850.  
1910

*H. venosa* Quél. (nec Schw.) Quél. esp. Myc. fr. 10th suppl., p. 672. 1881.

*H. plebophora* Sacc. (nec Pat.) Syll. 8: 20. 1889.

*Quelet's original description.* Stipe court, plein, à la fin creux, lacuneux, cannelé, pruineux, gris ou bistre. Mitre bilobée, comprimée puis réfléchie et festonnée, veinée réticulée, gris clair. Hymenium glabre, brun bistré. Spore ellipsoïde ( $O^{mm}$  016-18), ocellée.

Été.—Dans les forêts de la plaine. Il me paraît distinct du *sulcata* auquel je l'avais réuni comme variété. (Pl. VIII, fig. 15.)

Late in the autumn during three successive years the writers have collected plants which they have referred to this species along the marshy wooded banks of a small sluggish stream on Mt. Toby near Sunderland. They grow from mossy rotten logs and limbs which are partly submerged in the stream, moss-covered rocks, muck, or leaf-mold but always very close to the water. Frequently specimens were found completely submerged. Because we were never fully satisfied as to the identity of these plants, very full notes were always recorded. The following description is condensed from notes on some fifty fresh specimens collected during the three years:

Pileus not saddle-shaped or compressed (except occasionally in young stages), usually convex and somewhat agariciform, irregularly undulating on the upper surface, thin and weak, easily splitting back from the wavy margin, drooping and sometimes adnate to the costae, but most often found with margins entirely free, 1-3 cm. broad, usually fuscous above, but occasionally lighter (to smoke-gray of Ridgway), lower surface concolorous with the stipe. The costae from the stipe continue outward on the lower surface of the pileus as prominent radiating and branching veins disappearing toward the margin (See fig. 7). Stipe even or frequently attenuate downward, glabrous, smoke-gray or sometimes lighter (to almost white), 2-4 cm. high by 4-7 mm. in diam., sulcate-costate, the costae narrow and high, only rarely anastomosing, entire stipe composed of these solid plate-like costae united by their inner edges. Asci 200-300  $\times$  16-20 $\mu$ , cylindrical, with 8 uniseriate spores. Spores ellipsoidal, hyaline, smooth, with large central oil drop, 14-18  $\times$  10-12 $\mu$ . Paraphyses of the same height or a little longer than the asci, septate, slender, gradually enlarging upward to 5-6 $\mu$ . (Pl. II, figs. 6, 7.)

The microscopic characters of the species are not distinctive but in the very prominent veins which spread over the lower surface of the free pileus it is very distinct from any other species which we have found here.

The plants seem very much like *H. palustris* of Peck both in form and in habit and were at first referred there, but Peck does

not describe that species as having a venose inferior surface and it seems hardly probable that so prominent a character as this should escape the attention of so keen an observer. Examination of Peck's specimens of *H. palustris* (in imperfect condition, to be sure) failed to show this character. *H. palustris* is also a more slender species and is said to have a darker stipe. Both Quélet and Saccardo find *H. Queletiana* very closely related to *H. sulcata* (= *H. lacunosa*) and we were at first inclined to regard it as a synonym, but we have found the two species growing only a few feet apart and as seen in the field they appear very distinct. This venose lower surface is also possessed by *H. fusca* Gill. and *H. subcostata* Cke. All three agree also in the rather free pileus and sulcate stipe. Study of a wide range of material might show that they were not all distinct.

*Massachusetts Collections:* 'Sunderland, Sept. 1917 (Anderson). Oct. 1919. (Anderson), Oct. 1920. (Ickis & Anderson) M. A. C. Herb. 2283, 2816, 2823. Apparently a rare species, no other collections having been recorded from this state and very few from elsewhere.

5. *HELVELLA NIGRA* Peck, Bul. Tor. Club 26: 70. 1899

*Peck's description.* Pileus irregular, cupular, 1.5-2 cm. broad, externally velvety with short few-celled blackish brown or black septate hairs, hymenium even, black; stem 1.5-2 cm. long, solid, deeply sulcate and lacunosely pitted, velvety, black; asci 8-spored, 150-200 $\mu$  long, 12-15 $\mu$  broad; spores elliptic, 15-20 $\mu$  long, 10-12 $\mu$  broad; usually containing a single large shining nucleus.

Ashes of an old camp fire, Mt. Katadin, Me., Sept., F. L. Harvey.

This species is externally black and everywhere clothed with short thick black hairs except on the hymenium, but the inner substance is white. It is peculiar in having a cup-shaped though wavy and irregular ascomate or pileus. It is possible that this may become reflexed or deflexed with age, but I have seen no such specimens. The stem is rather long and conspicuously sulcate and lacunose and on this account I have referred the species to the genus *Helvella* rather than to *Acetabularia*. The hymenium is sometimes suffused with a white pruinosity.

No collections of this species have been reported from Massachusetts and we can add nothing to the above description. The length and furrowing of the stipe seem to us to be hardly sufficient basis for calling this plant a *Helvella*, since neither of these characters is lacking in the Pezizales where the cup-like upright pileus would seem to place the species in the genus *Acetabula*.

6. *HELVELLA EPHIPIUM* Lév. Ann. Sci. Nat. II. 16: 240. pl. 15, fig. 7. 1841

*Leveillé's original description.* Gregaria, villosa, cinerea; pileo 2-3-lobo, deflexo, libero; stipite cylindrico, laevi, farcto.<sup>1</sup> Hab. circa Parisios, ad terram in graminosis. Aestate.

Pileus firm, smooth, rather tough and membranaceous, at first pezizoid, then becoming saddle-shaped by the elevation of two opposite sides and the depression of the intervening margins, 1-3 cm. broad, margin always free from the stipe, smoke brown or bistre above, cinereous and scurfy villose below with tufts of converging, closely septate, moniliform, brown hairs increasing to 12-15 $\mu$  in thickness at their apices. Stipe slender, attenuate upward, scurfy-villose like the lower surface of pileus, stuffed, terete, tough, elastic, cinereous, 1-3.3 cm. high by 2-5 mm. diam. at the base. Asci 200-300  $\times$  14-18 $\mu$ . Spores hyaline, smooth, ellipsoidal, with large central oil drop, 14-18  $\times$  10-12 $\mu$ . Paraphyses slender, septate, enlarged upward, brown-tinted. (Pl. 12, figs. 18-20.)

Gregarious, on the ground in grassy places and thin woods. Common in late summer and autumn.

Our specimens have been very dark gray, some of them fuscous-black. The pezizoid character is very prominent and although the older ones are frequently saddle-shaped, they become so in the manner described above and not because the lobes are reflexed from the first as in *H. atra*. We find with Leveillé however that the shape is not very constant. Many of the stipes were partly buried and in all cases a round ball of earth adheres to the base of the stipe, making it appear at first bulbous. The hairs on the lower surface are longer and the scurfy-villose character more prominent than in *H. atra*, giving the plant an almost shaggy appearance. The spores are described

<sup>1</sup> A long note follows this brief diagnosis in the original.

by Leveillé as round but we find them much the same as in other species of the genus except perhaps that they are a little smaller (14-16 $\mu$  long in our specimens).

In this species we have a connecting link between the *Helvella* and the *Pezizales*. One who sees only the younger cupular ascomata is inclined to place it among the latter but in more mature stages the helvelloid character appears.

*Massachusetts Collections.* Sunderland, Sept., 1919 (Anderson & G. W. Martin) M. A. C. Herb. 2644; Leverett, Oct., 1920 (Ickis). There are specimens under this name in the Harvard herbarium, collected by Mrs. Sanger at Manchester, Mass., in Aug. 1906, but they could hardly be *H. ephippium* as we know it, since they are much larger, have lacunose stipes, and the margins of the pilei are adnate.

In Peck's herbarium there are two packets of this species from Mass., one from G. E. Morris, of Waltham, and the other from Miss Hallowell, but no localities or dates are given.

7. *HELVELLA ELASTICA* Fr. Sys. Myc. 2: 21. 1823

*Boleto-lichen vulgaris* Jus. Mem. Ac. Sc. Paris 1728, p. 268.

*Elvela fuliginosa* Schaeff. Fung. t. 320. Index, p. 113. 1770.

*H. elastica* Bull. Champ. fr. p. 299. t. 242. 1785.

*H. Mitra* Bolt. Hist. fung. t. 95. 1789.

*H. albida* Pers. Syn. Meth. fung. p. 616. 1801.

*H. gracilis* Pk. N. Y. Sta. Mus. Nat. Hist. Rpt. 24 (for 1870): 94. 1872.

*Leptopodia elastica* Boud. Bul. Soc. Myc. Fr. 1: 99. 1885.

*Elvella albella* Quél. Bul. ass'n. fr. Adv. Sci. 1895: 621. t. 6, f. 6.

*Leptopodia albella* (Quél.) Boud. Ic. Myc. 4: 123. 1910.

*Helvella capucinoides* Pk. N. Y. State Mus. Bul. 157: 27. 1912. (Rpt. State Bot. for 1911.)

*Fries' description.* Pileo libero laevi inflato, demum acute lobato, stipite elongato tenui attenuato pruinoso.

Gracilis, 3-4 unc. alta, elastica, pellucens. Stipes junior farctus, dein fistulosus, basi incrassatus, saepe irregulariter lacunosus. Pileus unciam vix attingens, 2-3-lobus, subinde orbicularis leviter plicatus.

Pileus smooth or undulate, firm, deflexed and rolled backward,

saddle-shaped or irregularly 2-3-lobed, usually tilted—so much so in some cases that it is almost vertical and the reflexed lobes encircle the stipe—margin even or wavy and free from the stipe, upper surface light-drab, smoke-gray or yellow but often found darker, through various shades of gray-brown or fuliginous, 1-3.5 cm. broad, lower surface white, pruinose to tomentose, usually areolate. Stipe slender, smooth and terete or frequently somewhat uneven and undulating, compressed at places or lacunose but never sulcate-costate, attenuate upward, pruinose to tomentose, 3-10 cm. high by 4-8 mm. diam. at the base, pure-white, sometimes darker toward the base and exhibiting there the same colors as the pileus, stuffed or finally hollow. Asci  $200-300 \times 12-18\mu$ . Spores ellipsoidal, smooth, hyaline,  $17-20 \times 10-12\mu$ , with large central oil drop. Paraphyses slender, septate, clavate, hyaline. (*Pl. 12, figs. 8-15.*)

On the ground and sometimes on wet rotten logs in the woods. Common in autumn.

The shape of the pileus is extremely variable. It only rarely appears to be set squarely on the top of the stipe but in our specimens has almost always been tilted at various angles as indicated by our photographs. If tilted to nearly the vertical position, the reflexed margins roll closely about the top of the stipe. Sometimes longitudinal lacunae on opposite sides extend clear through the stipe, the fissure thus formed making the stipe appear double for a part of its length (fig. 8). The stipe is always slender; we have never found one that was as much as 1 cm. in diameter; it is difficult for us to believe that they become 1 inch thick in Minn. as described by Miss Hone. *H. albella* Quél. (= *Leptopodia albella* of Boudier) is separated on the basis of a darker colored pileus. In view of the well-known variations in the shade of the pileus such a character would hardly seem sufficient for separating a species. In his supplement to Vol. II of the *Systema Mycologicum*, Fries states that he has seen many varieties of colors, snow-white, brown, etc.

Peck describes his new species *H. gracilis* as having the upper surface of the pileus pale-yellow, but in all other respects his description agrees with that of *H. elastica*. Cook (*Mycogr.* 1 (1): 91 and fig. 162) after examining the specimens of *H. gracilis* which Peck sent to him says: Size and habit that of *H. elastica*, wholly ochraceous. Sporidia  $18-20 \times 12\mu$ . It is appar-



ently only different in color from the usual condition of *H. elastica*, of which it is probably only a variety." His figure shows the plant wholly ochraceous, but it was made from dried specimens and we frequently find exsiccati specimens of *H. elastica* entirely of that color. In a short key to the N. Y. species of *Helvella* (Rpt. 31: 59. 1879.) Peck separates *H. gracilis* from *H. elastica* on the basis of its glabrous stipe. But Cooke finds his specimens of *H. gracilis* with pruinose stipes. In the N. Y. State Herb. at Albany the writers had opportunity to study numerous collections of this species by Peck but it was impossible to determine whether any of them were type specimens since Peck seems rarely to have marked his type specimens as such and also quite commonly omitted the date of collection. In the dried state nothing could be found to distinguish them from *H. elastica*. Under the lens the stipes were plainly pruinose to tomentose. The stipe and lower surface are light-ochraceous-buff, warm-buff or pinkish-buff; the upper surface varies from cinnamon-buff or clay-color to cinnamon-rufous and chestnut-brown. A drawing by Peck along with these specimens shows the upper surface of the pileus cream-buff. The form with the brown pileus is less frequent but not uncommon in this state. In Farlow's herbarium at Harvard there are a number of excellent specimens which Dr. Farlow collected at Williamstown and sent to Boudier who identified them as *Leptopodia albella*. Through some confusion of names they are labelled *H. albipes*, a species which probably does not occur in America and even in the dried condition could hardly be mistaken for *H. elastica*. Careful examination failed to show any distinction between the Williamstown specimens and other specimens which are in the Harvard and other herbaria under *H. elastica*.

Peck describes the color of the upper surface of the pileus of his new species *H. capucinoides* as smoky-ochraceous, becoming brown or ochraceous brown with age; the spores  $20-28 \times 12-16$ . A large number of the type specimens of this species at Albany were studied. The pileus was bistre to snuff-brown in color. The plants in all respects seem to agree with the exsiccati of *H. elastica* which we have seen in various other herbaria. The

spores measured  $18-20 \times 10-12\mu$  and were in every way like those of *H. elastica*. Exsiccati specimens of *H. elastica* compared with Ridgway's color standard plates, are light-ochraceous-buff, warm-buff, ochraceous-tawny or ochraceous-buff on the stipe and under surface of the pileus. The upper surface varies widely, ochraceous-tawny, russet, Mars-brown, Rood's-brown, sepia to fuscous-black. It seems probable that the shade which the specimen finally assumes might be largely influenced by its condition when collected and especially by the rapidity and conditions under which it was dried.

A variety having the lower surface of the pileus and the stipe fuscous but otherwise like *H. elastica* has been reported from Vermont by Burt (1899) as *H. elastica* var. *fusca* Bull. (Champ. Fr. pl. 242, fig. D). Fig. D of Bulliard's plate 242, however, does not show the lower surfaces of pileus and stipe to be different in color from other plants figured on the same plate and we are at a loss to locate the authority for the variety. We have not seen specimens of it in Massachusetts.

*Massachusetts Collections:* Frost included this species in his list of fungi within thirty miles of Amherst College but no locality was mentioned. Underwood also writes that he collected it in this state. Manchester, Sept. 1890 (Sturgis) in Harv. Herb.; Williamstown, Sept. 1901 (Farlow) in Harv. Herb.; Prides Crossing, Sept. 1901 (J. F. Conant), Bost. Myc. Herb.; Amherst and Sunderland, Sept. and Oct. 1919 and 1920, (Anderson & Ickis) M. A. C. Herb. 2716, 2732, 2813. Probably as common as any species of *Helvella* in New England.

8. *HELVELLA ADHAERENS* Peck. N. Y. State Mus. Bul. 54: 956. pl. 50, figs. 11-15. (Rpt. of Botanist for 1901.) 1902

*Peck's original description.* Pileus thin, irregular, deflexed, whitish or smoky white, becoming brownish with age or in drying, the lower margin attached to the stem, even and whitish beneath; stem slender, even, solid, pruinose downy, smoky white or brownish, the upper part concealed by the deflexed pileus and smaller than the lower exposed part; asci cylindric, 8-spored; spores elliptic, often uninucleate, .0007-.0008 of an inch long, .0005 broad; paraphyses filiform, hyaline, thickened or subclavate at the top.

Ground in woods. Bolton and Hague. August and September. Related to *H. elastica*, from which it is easily distinguished by having the deflexed margin of the pileus attached to the stem. When young and fresh the whole plant is whitish or dingy white, but it is apt to become brownish with age or in drying.

In 1879 Peck (Rpt. 31: 59) stated that he sometimes found the margin of the pileus adnate to the stem in *H. elastica*. In the present description he states that *H. adhaerens* differs from *H. elastica* in that the pileus margin of the former is adnate. The two statements in conjunction indicate that he had now decided that those plants of *H. elastica* in which the margins were attached should be placed in a separate and new species which he now describes.

Four different collections of *H. adhaerens* in the Peck herbarium at Albany were examined. Apparently two species have been confused there, one a tall species which looks very similar to *H. elastica* except for the adnate pileus and a slightly darker color; the other a smaller, very dark form with densely hairy stipe which has every character of *H. atra*. From Peck's description it seems likely that the first is the true *H. adhaerens*.

There is no record of the occurrence of this species in Massachusetts and we can add nothing to Peck's description.

#### 9. HELVELLA ATRA Fr. Sys. Myc. 2: 19. 1823

*H. atra* Oed. Fl. Dan. Fasc. 9: 7. 1770.

*H. nigricans* Pers. Obs. myc. 1: 72. 1796.

*Leptopodia atra* (König) Boud. Hist. et. Class. Disc., p. 37. 1907.

*Fries' description.* Fuligineo-nigra, pileo deflexo utrinque adpresso libero, subtus laevi, stipite farcto furfuraceo-villoso.

Solitaria, minor, *H. infulae* analoga. Stipes 1-2 unc. longus, 1-2 lin. crassus, teretiusculus, laevis l. irregulariter lacunosus, nigricans, basi subolivaceo-cinerascens. Pileus iam ab initio deflexus, nec pezizoideus uti sequ., compressus, biloboemarginatus, ½ unc. l. parum ultra latus, laevis, demum leviter repandus, subtus & exsiccatus cinerascens.

Pileus firm, smooth, reflexed, compressed-saddle-shaped, with the opposite drooping margins at first (in all our specimens) adnate with the stipe, 1-2.5 cm. broad, smoke-gray to fuliginous

above and below, lower surface smooth and velvety or scurfy-villose. Stipe smooth and terete or unevenly undulate or flattened or with some lacunae, especially toward the base but never sulcate-costate, attenuate upward, fuscous to fuscous-black but gray at the extreme base, villose like the lower surface of the pileus, stuffed, 2-5 cm. high and 2-7 mm. thick at the base. Asci 200-300  $\times$  15-18 $\mu$ , cylindrical. Spores smooth, hyaline, ellipsoidal, with one large and a number of much smaller oil drops, 15-20  $\times$  9-12 $\mu$ . Paraphyses slender, septate, enlarging upward to 8-9 $\mu$ , hyaline to yellow-brown-tinted. (Pl. 12, figs. 16-17.)

Gregarious on the ground and on wet rotten logs in the woods in autumn.

We have found this species but once in this state and since this is the only recorded collection from New England, we judge that the species is rare with us. Five specimens were found growing on a very wet rotten maple log, in the edge of a swamp in October. In all of our specimens the margins of the pileus are adnate with the stipe but Fries and Rehm describe the pileus as free. Bresadola, Boudier, Massee and others find that it is sometimes adnate. In the face of such conflicting statements it seems best to describe it as sometimes adnate. In other respects our specimens agree very closely with the descriptions of Fries and Rehm. There is also some variation in the color of the upper surface of the pileus; Fries describes it as fuliginous, Rehm as smoke brown, Massee as sooty-black or black with a purple shade becoming dingy-gray, Gillet presents a figure in which it is grayish-white, etc. The pilei of our specimens were smoke-gray to deep-mouse-gray while the stipes were fuscous to fuscous-black, much darker than the pilei but gray at the extreme base. Rehm finds a close relationship between this species and *H. pezizoides* and *H. ephippium* but if our specimens are typical, it is very easily distinguished from the two latter species by the regularly saddle-shaped pileus, deflexed and compressed, adnate and not at all pezizoid. The main points of resemblance are the dark color and the villose stipe and under surface of the pileus. The adnate margins distinguish it from all the forms of *H. elastica*. It also differs in the color of the stipe from all of them (except *H. elastica* var. *fusca*) and in the villose character of the lower sur-

face and stipe, The very dark color of the stipe distinguishes it from *H. adhaerens*.

*Massachusetts Collections:* Sunderland, Oct. 1920 (Ickis & Anderson) M. A. C. Herb. 2825. Apparently rare.

10. *HELVELLA MONACHELLA* Fr. Sys. Myc. 2: 18. 1823

*Morchella monacella* Port. Hist. X, c. 70. 1592.

*Fungoidea fungiformia* 6. Mich. N. Pl. Gen. p. 204. 1729.

*Boletus albus* Batt. Fun. Agr. ari. Hist. p. 24, t. 2, f. H. 1759.

*Phallus monacella* Scop. Fl. Carn. 2: 476. 1772.

*Elvela spadicea* Schaeff. Fung. 4: index p. 112. t. 283. 1770.

*Helvela grandis* Cum. Act. Ac. Taurin, t. 2. 1805.

*Fries' description.* Pileo deflexo lobato adnato laevi subspadiceo, stipite cavo laevi glabro albo.

Antecedenti proxima, sed notis allatis & vegetatione vernali bene distincta. Stipes 1-2 unc. longus, sursum attenuatus,  $\frac{1}{2}$  unc. vix crassus, primo teres; dein subcompressus versus basin lacuna notatus. Pileus demum crispus et undulatus, colore varius, badius, spadiceus, violaceus, nigrescens, etc.

Pileus irregularly lobed, undulate, deflexed and adnate to the stipe, 3-6 cm. broad, pale-brown, chestnut-brown or darker to violaceous or blackish above, much lighter below. Stipe terete or somewhat compressed, smooth, hollow, somewhat swollen below, attenuate upward, minutely pubescent but becoming glabrous, 2-5 cm. high, 1 cm. thick, white. Asci cylindrical. Spores ellipsoidal, hyaline, smooth, with large central oil drop,  $16-18 \times 10\mu$ . Paraphyses slender, septate, enlarging upward, brown at the tips.

Solitary in woods on the ground in spring.

The writers have not seen a fresh plant of this species; the above description being taken from those of Fries, Rehm, Massee, Gillet, and others. It appears to be a rare plant in America, having been reported only from New England and California. It is said to be common in Italy but even the European literature is scanty and based on very few collections. Rehm has well said that the species is in need of further investigation; it is doubly true of American collections. Fries finds that it is very closely related to *H. Infula* (*Gyromitra*), and on comparing his descriptions of the two species, one wonders what the important morphological differences are. It differs from all our other *Helvel-*

lae and at the same time agrees with our *Gyromitra* in its vernal habit. Its size, color and stout stipe also indicate a relationship to *Gyromitra*. The spores as described by Rehm are like those of *Helvella* rather than *Gyromitra*. In the few herbarium specimens which we have found and examined microscopically the spores were biguttulate and we are inclined to believe that the specimens were incorrectly referred to this species. We have included a consideration of this species in this paper, even though based on very scanty data in the hope that mycologists might be induced to look more carefully for it and settle the question as to its identity.

*Massachusetts Collections:* Sprague (1858) included this species in his second list of New England fungi and indicates by the context that it was collected in the vicinity of Boston. Morris (1918) has doubtfully attached this name to a drawing of a species which he collected at Ellis in Sept. 1913. If it was *H. Monachella*, it differed from the European plant in its autumnal occurrence.

II. MACROPODIA MACROPUS (Pers.) Fckl. Sym. Myc. p. 331.  
1871

*Helvella macropus* Karst. Myc. fenn. 1: 37. 1871. (For full synonymy, see Rehm, Rabh. Krypt. Fl. Bd. I, Abt. 3: 985. 1896.)

Pileus at first globose and closed, then opening to expose the grayish-brown hymenial surface, which is at first cup-shaped, then saucer-shaped, 1-3 cm. broad, smooth above, coriaceous, fragile. Stipe cylindrical, 1-4 cm. high, 1-3 mm. in diameter, hollow, attenuate upward, frequently somewhat lacunose. The stipe and lower surface of the pileus are gray, scurfy-villose, with tufts of closely septate moniliform clavate hairs, 10-12 $\mu$  thick at their apices. Asci cylindrical, 300-350 $\mu$   $\times$  14-16 $\mu$ . Spores ellipsoid-fusiform, hyaline, smooth or sometimes rough, mostly with a large central oil drop, 18-25  $\times$  10-12 $\mu$ . Paraphyses slender, septate, enlarging upward to 8 $\mu$ , yellowish.

This is not a true *Helvella* but is included in this paper because frequently called a *Helvella* (following Karsten), and because it is commonly found in Massachusetts. The early closed

condition of the ascoma and its more permanent cup-shape place it among the Pezizales rather than among the Helvellales. Phillips (1893) finds however that the cups sometimes become expanded or even reflexed. In this condition it would be more easily taken for a *Helvella*. The above description is taken largely from Rehm. Masee describes the plants as somewhat larger, 2-5 cm. broad and 3-7 cm. high; also he finds the spores  $28-33 \times 11-13\mu$ . Boudier (Icon. Myc. 4: 126) finds that it sometimes grows 10 cm. high, never reflexed, the spores having usually 3 oil drops,  $24-29 \times 11-12\mu$ , fusiform. Among the Massachusetts Helvellae it is most closely related to *H. ephippium*, from which species it is probably most easily separated by its larger ellipsoid-fusiform spores.

Peck (Bul. Tor. Club 29: 74. 1902) described *Helvella macropus* v. *brevis* from some small specimens which were sent to him from this state by Morris. Stipe 8-16 mm. long and pileus 8-16 mm. broad, hymenial surface black or nearly so. These differences seem hardly sufficient basis for the separation of a variety. The writers studied the type specimens at Albany as well as another collection sent to Peck by Simon Davis from Mass. The specimens were very similar to our exsiccata of *H. ephippium*, but the spores are distinctly fusiform, minutely tuberculate and measure  $18-25 \times 10-12\mu$ , corresponding in every respect with those of *Macropodia macropus*.

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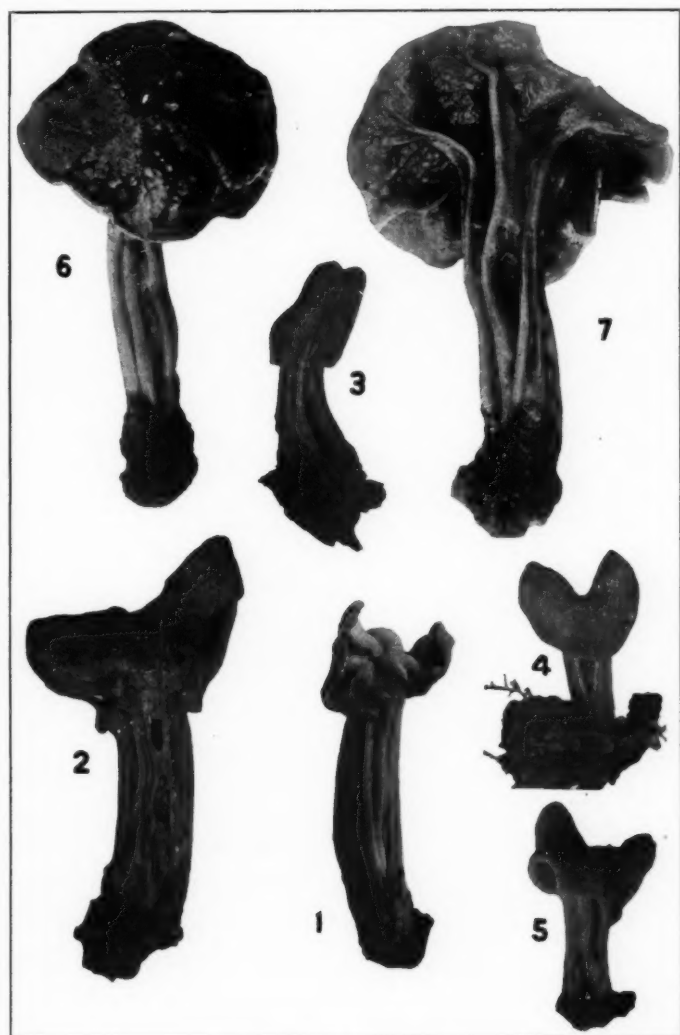
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## INDEX TO SPECIES

(Synonyms and excluded species in *italics*)

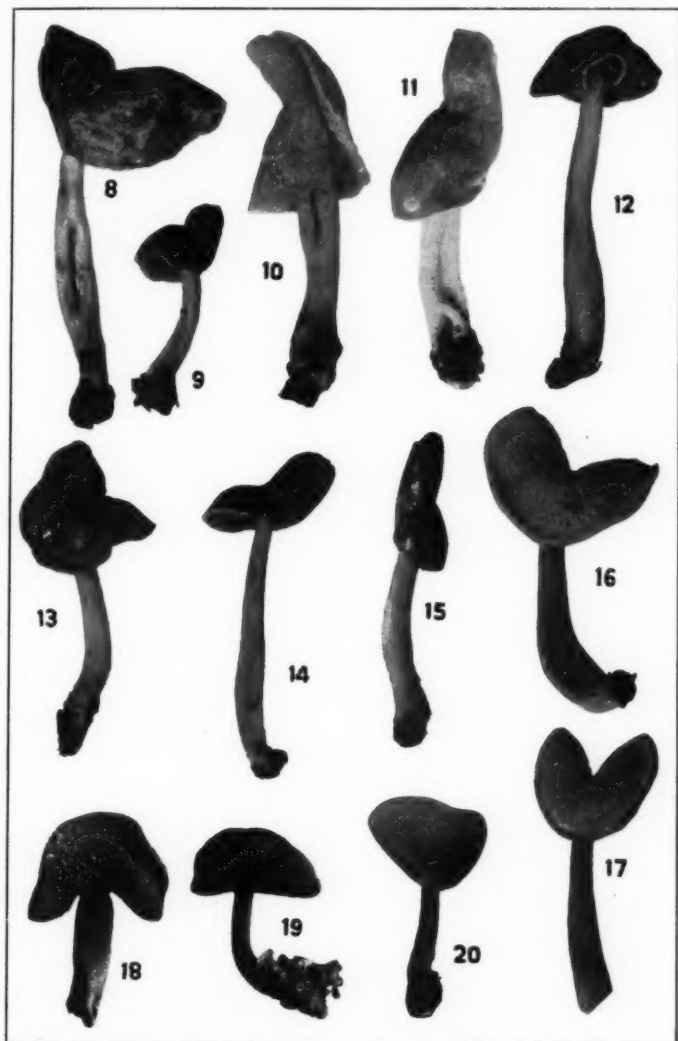
<i>acaulis</i> = <i>Rhizina undulata</i>	<i>elastica</i> , 7
<i>adhaerens</i> , 8	<i>elastica</i> ( <i>Leptopodia</i> ), 7
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SPECIES OF HELVELLA





SPECIES OF *HELVELLA*



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<i>macropus</i> ( <i>Aleuria</i> ), 11	<i>plebophora</i> , 4
<i>macropus</i> ( <i>Lachnea</i> ), 11	<i>Queletiana</i> , 4
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<i>mitra</i> v. <i>fulva</i> , 1	<i>sulcata</i> , 2
<i>monacella</i> , 2, 10	<i>venosa</i> , 4
<i>monacella</i> ( <i>Morchella</i> ), 10	<i>villosa</i> ( <i>Octospora</i> ), 11
<i>monacella</i> ( <i>Phallus</i> ), 10	<i>vulgaris</i> ( <i>Boleto-lichen</i> ), 7

EXPLANATION OF PLATES

PLATE 11

- Fig. 1. *H. crispa*.  $\times 1$ .  
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- Figs. 8-15. *H. elastica*.  $\times 2/3$ .  
 Figs. 16-17. *H. atra*.  $\times 1$ .  
 Figs. 18-20. *H. ephippium*.  $\times 2$ .

## MEMORANDA AND INDEX OF CULTURES OF UREDINEAE, 1899-1917<sup>1</sup>

J. C. ARTHUR

The cultures of the rusts, which were conducted under the auspices of the Purdue University Agricultural Experiment Station, and extended over a period of nineteen years, had a small beginning. For the first three years only such time was given to the work as the writer could spare from his duties as head of the Botanical Department of the Station and as Professor of Vegetable Physiology and Pathology in Purdue University. In most of the following years an assistant was especially employed during two or so months each spring, who had entire charge of the testing of spore viability, sowing of the spores, and care of the inoculated plants, the chief part of the culture work being done during May and June. The position was held by fourteen individuals, selected with the needs of the work especially in view, and ranging from a junior high school student to university instructors, who without exception showed superior ability in conducting the work. Financial support was provided by a grant from the Botanical Society of America in 1903, 1906 and 1907, and by coöperation with the Bureau of Plant Industry of the U. S. Department of Agriculture in 1904 and 1905. In the other years it was supplied by the Purdue University Agricultural Experiment Station, and from 1908 onward the work was made a part of the rust project under the Adams fund.

During the progress of the work the writer, usually accompanied by an associate, made many shorter or longer excursions for securing data and material. These field observations were directed toward detecting the juxtaposition of spore-forms that might be supposed to have genetic connection, as well as toward securing suitable culture material. The fruitfulness of this method is apparent from the fact that during the extended study

<sup>1</sup> Contribution from the Botanical Department of the Purdue University Agricultural Experiment Station.

of heteroecious species only three times was a discovery of alternate hosts effected that was not the outcome of a previous field observation. In two of these cases, that of *Uromyces acuminatus* (more properly *U. Steironematis*, see page 76,\* Jour. Myc. 12: 25), and *Puccinia Ceanothi* (see page 196,\* Mycologia 4: 27) sowings were made on all available hosts in the greenhouse, recorded as bearing aecia, and in the case of *P. fraxinata* (*P. peridermiospora*, see page 8,\* Bot. Gazette 29: 275), a morphological similarity was detected between aesciospores and urediniospores, leading to successful cultures.

Beginning with the immediate vicinity of Lafayette, Indiana, the range of observations was extended to various parts of the state, and in the ninth year of the work, 1907, to other states. This year a trip was made to the foothills of Colorado, which was repeated in 1908, 1911 and 1916, observations being made from Boulder to Trinidad, and once westward to Ouray and Durango. Between 1908 and 1916 trips were made northward to Wisconsin and Michigan, eastward to Maine and Pennsylvania, to South Carolina, Alabama and Mississippi in the south, and to Texas, New Mexico and Arizona in the southwest. So far as possible places were selected where there were local collectors, or where records showed that species requiring investigation had at some time been secured. The chief collecting grounds of Ellis in New Jersey, Ravenel in North and South Carolina, Atkinson and Underwood in Alabama, and Kellerman in Kansas were visited, and the collecting grounds of Schweinitz at Salem, North Carolina, and Bethlehem, Pennsylvania, would have been visited, if opportunity had favored. In this way many obscure names in the literature were connected with living material on which fresh and more extended studies, often including cultures, could be carried out. By this method the attention given to the genus *Gymnosporangium* was made to expand our limited knowledge of a few species into an understanding of the life history of some two dozen species and of their alternate hosts. The effectiveness of the work with *Gymnosporangium* was greatly enhanced by the special interest in it taken by my asso-

\* For explanation of these page numbers see p. 246 at beginning of the index.

ciate, Dr. F. D. Kern, who for ten years took part in the culture work. The grass and sedge rusts were, however, the ones that received the most extended and prolonged attention.

To carry on the work more than 2140 collections with resting spores were available, together with over 250 collections with spores not requiring a resting period. Tests of all of these, and of some many times repeated, showed that not all were viable, at least at the time tested, and therefore not serviceable. This material was provided in part by those directly connected with the work, and to a considerable extent by more than 85 botanical correspondents, many of whom contributed most generously in material and field observations year after year. Altogether about 3750 sowings, that is, attempts at cultures were made, of which about one in seven resulted in successful infection of the host. These tests were almost wholly made in a greenhouse, although a few were conducted in the open field when small plants suitable for placing in pots were not available.

It is difficult to say just how many species have been grown through some part of their life cycle during the nineteen-year period, owing to the constant shifting of accepted names as knowledge regarding them accumulated. Probably the list includes about one hundred species, as they are now rated, or nearly twice as many as they would at first have been listed, and of this number about eight were heteroecious to one autoecious. Of the heteroecious species some twenty were verifications of combinations previously established, mostly by European investigators, while about sixty-five provided alternate hosts for species whose life cycle was before unknown, most of these being grass and sedge forms not known outside of North America.

When viewing the present location of the New York Botanical Garden many years ago, it then being a rolling meadow without buildings of any kind, my companion, Professor L. M. Underwood, remarked that some day I might be called upon to supply the rust portion for the projected North American Flora, and added that if I did so he had no doubt that I would greatly reduce the number of species. The culture studies have enabled me to do this, but not quite in the way Professor Underwood



and others at that time had in mind. In many cases the first results have been to increase the number of species. Thus *Puccinia alternans* and *P. obliterated* were described as new species as result of cultures, but as the studies proceeded were reduced to synonyms of the long recognized *P. Agropyri*, together with *Aecidium Aquilegiae*, *A. Clematidis*, *Puccinia tomipara*, *P. Paniculariae*, and some others. But on the whole, as the cultures have largely dealt with heteroecious species, there has been a reduction in names as the alternate forms were brought together, and sometimes by the recognition as races of forms that were once thought distinct species.

The nomenclature of the reports has been made as conservative as possible, in order to give them reasonable uniformity. The new generic names proposed by the writer in 1906 at the Vienna Congress scarcely find an echo in them, while on the other hand the terminology for spore-forms, brought out in 1905, was put into use in the second report following, and proved highly serviceable.

In the various reports of the cultures, and as a result of them, the following thirteen specific names were transferred to other genera: *Aecidium magnatum* Arth. and *A. Silphii* Sydow to *Uromyces*, *Aecidium Ceanothi* Peck, *A. Impatientis* Schw., *A. Jamesianum* Peck, *A. macrosporum* Peck, *A. monoicum* Peck, *A. Pammelii* Trel., *A. Phrymae* Halst., *A. pustulata* Curt., *A. Sambuci* Schw. to *Puccinia*, and *Puccinia tumidipes* Peck and *P. Vernoniae* Berk. & Curt. to *Bullaria*.

Also as the result of the cultures the following sixteen species were described as new: *Gymnosporangium corniculans* Kern, *G. exterum* Arth. & Kern, *G. trachysorum* Kern, and on the authority of the writer *Puccinia albiperidia*, *P. alternans*, *P. Caricis-Asteris*, *P. Caricis-Erigerontis*, *P. Caricis-Solidaginis*, *P. Eatoniae*, *P. Koeleriae*, *P. obliterated*, *P. patruelis*, *P. universalis*, *Uromyces effusus*, *U. Solidagini-Caricis*, and *U. Steironematis*, but as the result of further studies most of these were subsequently buried in synonymy.

## CORRECTIONS

In making corrections the consecutive page numbers used are those explained below at the beginning of the index, while the original pages are given in parentheses. A few of the corrections are typographical errors, or slips of the pen, but many are necessitated by information variously acquired after the reports were written and printed. Evident and inconsequential errors are not included. To save space the following abbreviations are used in the parentheses: B.G. for Botanical Gazette, J.M. for Journal of Mycology, and My. for Mycologia, and are followed by the original volume and page number.

Pages 5, 9 (B.G. 29: 272, 276), under 7 and 3 respectively, for "Americana Lagh." and "Americana," read *Andropogonis* Schw. and *Andropogonis*, respectively, and for "Andropogi Schw." and "Andropogi," read *Ellisiana* Thüm. and *Ellisiana*, respectively.

Pages 7, 9, 22, 28 (B.G. 29: 274, 276; 35: 16, 22), for "K. & S.," read E. & K.

Pages 8, 31, 51, 60, 67, 75, 76, 77, 78, 83, 103, 106, 114, 127, 146, 156, 160, 164, 174 (B.G. 29: 275; J.M. 10: 9; 11: 57, 66; 12: 16, 24, 25, 26, 27; 13: 192; 14: 14, 17, 25; My. 1: 236, 255; 2: 221, 225, 229, 239), for the species of *Spartina*, given as "cynosuroides" or "cynosuroides Willd.," read *Michauxiana* or *Michauxiana* Hitchc. The two species of grass were for a time confused and one name used for both.

Pages 11, 65, 77, 86, 94 (J.M. 8: 52; 12: 14, 26; 13: 196, 204), for a species of *Carex*, for "tetanica" and "tetanica Schk.," read *blanda* and *blanda* Dewey, respectively.

Pages 17, 45, 49, 50, 60 (B.G. 35: 11; J.M. 11: 51, 55, 56, 66), for the species of *Lepidium*, given as "apetalum" and "apetalum Willd.," read *densiflorum* and *densiflorum* Schrad., respectively.

Page 26 (B.G. 35: 20), the *Accidium* mentioned under 5. *P. AMPHIGENA* was subsequently found not to be *A. Smilacis* Schw.

Pages 41, 42 (J.M. 10: 19, 20). The supposed infection in 1903 of *Bromus ciliatus* by the application of aeciospores from *Dirca palustris* was the most serious error that occurred in the nineteen years of culture work. The grass used for the culture was undoubtedly infected before the sowing was made, as explained on pages 56 and 57 of the report following. The combination of aecia and telia under the name "*Puccinia hydnoidea*," was unwarranted. The *Accidium hydnoideum* was under close observation during the whole culture period, and there were a score of attempts to find the alternate host, but even to the present writing no progress has been made.

Pages 49, 50 (J.M. 11: 55, 56), under no. 4, for the species of *Sophia* from Nebraska, given as "incisa (Engelm.) Greene," read *intermedia* Rydb.

Pages 49, 60, 68, 77 (J.M. 11: 55, 66; 12: 17, 26), for the species of *Sophia* from Indiana used in the cultures, given as "incisa" and "incisa (Engelm.) Greene," read *brachycarpa* and *brachycarpa* Rydb.

Pages 51, 60, 67, 77, 103, 114, 127, 146, 160, 174, (J.M. 11: 57, 66; 12: 16, 26; 14: 14, 25; My. 1: 236, 255; 2: 225, 239), after *Puccinia fraxinata*, for "Schw.," read Link.

Page 62, first line of reprint, for "1," read 12.

Page 64 (J.M. 12: 13), under no. 6, for "Schw.," read Desmaz.

Pages 66, 77 (J.M. 12: 15, 26), under no. 7, for specific name "*aquatilis*" and "*aquatilis* Wahl.," read *nebraskensis* and *nebraskensis* Dewey. On page 66 the comparison of the large, thick-walled urediniospores (common on this host, the form being known as *Puccinia Garretii* Arth.) to the amphispores of *P. Caricis-stictae* was an error. It may be pointed out here that the same mistake regarding name of the host also occurs in Sydow, *Uredineen* 2115, Barth. *Fungi Columb.* 2351 and 3838. *Carex nebraskensis* is a very common sedge about Denver and Boulder, Colo., while *C. aquatilis* is rare or possibly absent.

Pages 85, 92, 94 (J.M. 13: 195, 202, 204), under *Lactuca*, for "*virosa*," read *scariola*.

Pages 93, 95, 107, 114, 130, 146, 195, 201 (J.M. 13: 203, 205; 14: 18, 25; My. 1: 239, 255; 4: 26, 32), under *Gymnosporangium*, for "*Nelsoni* Arth.," read *juvenescens* Kern, and also delete the last sentence under no. 19 on page 107 (J.M. 14: 18). *Gymnosporangium Nelsoni* and *G. juvenescens* were for a time confused. Both produce aecia on *Amelanchier* and *Sorbus*, but the former gives rise to woody galls, often very small, while the latter is foliicolous.

Page 96, first line of the reprint for "1907," read 1908.

Pages 100, 180 (J.M. 14: 11; My. 4: 11), under *Puccinia*, for "*montanensis* Ellis," read *Agropyri* Ellis & Ev., as pointed out on page 263 (My. 8: 139).

Pages 109, 115 (J.M. 14: 20, 26), under no. 2, for "*Cryptandri* Ellis & Barth.," read *substerilis* Ellis & Ev., and for "*Sporobolus cryptandrus* (Torr.) A. Gray," read *Stipa viridula* Trin.

Pages 112, 115 (J.M. 14: 23, 26), under no. 6, for "*mutabilis* Ellis & Gall.," read *Blasdalei* Diet. & Holw., for "*reticulatum* Fraser," read *Brandegei* S. Wats., and for "*recurvatum* Rydb.," read *cernuum* Roth.

Page 123 (My. 1: 232), under no. 11, for "*Aster arenarioides* D. C. Eaton," read *Erigeron arenarioides* A. Gray.

Pages 129, 130, 146 (My. 1: 238, 239, 255), the small form of *Gymnosporangium* on *Juniperus virginiana*, which gave rise to pycnia and aecia on *Crataegus punctata*, should have been referred to *G. floriforme* Thaxter.

Page 133 (My. 1: 242), delete the entire paragraph beginning "The aecia of this species," etc., except the first sentence.

Page 147 (My. 1: 256), under no. 8, for "*glomerata*," read *mexicana* (L.).

Page 173 (My. 2: 238), under no. 1, change the reading thus: *Teliospores* on *Carex lanuginosa* Michx., sown on *Onagra biennis* (L.) Scop., and on *C. trichocarpa* Muhl. sown on *Gaura biennis* L.

Pages 178, 180 (My. 4: 9, 11), 19th and 6th line from bottom respectively, for "*Douglasii*," read *spartioides*.

Pages 180, 189, 197, 200, 231 (My. 4: 11, 20, 28, 31; 7: 72), as a species of *Senecio*, for "*lugens*" or "*lugens* A. Gray," read *spartioides* or *spartioides* T. & G., respectively.

Pages 197, 202 (My. 4: 28, 33), under no. 2, the material in hand from Isle au Haut, Me., was *Puc. quadriporula* (*P. Grossulariae*), but the results of infection were obtained from stray spores of *Uromyces perigynius*, as explained at page 235 (My. 7: 76) in the report of cultures for 1912.

Pages 256, 265 (My. 8: 132, 141), under no. 4, for "*Agropyri* E. & Ev. (*P. alternans* Arth.)," read *Cockerelliana* Bethel. This distinctive species was not recognized, and had not been named until long after the cultures were made.

Pages 257, 265, (My. 8: 133, 141), under no. 5, for "*Anchusa officinalis*," read *Lycopsis arvensis*.

Pages 261, 263, 265 (My. 8: 137, 139, 141), under no. 3, for "*montanensis* Ellis" and "*montanensis*," read *apocrypta* Ellis & Tracy and *apocrypta*, respectively. On page 262 three species are confused. *Puccinia apocrypta* is not a synonym of *P. Agropyri*. The characters given for *P. apocrypta* are those of the true *P. montanensis*, for which the type is the collection cited.

Pages 274, 275 (My. 9: 302, 303), under no. 2, for "*B. & C.*" read Schw.

#### SUMMARY OF CULTURES

In order to give a clearer perspective of the work, and to make the data more readily available, the following tabulation is given of the heteroecious species that were successfully grown on alternate hosts. Autoecious species, and heteroecious species grown from urediniospores or amphispores only, have not been included. The years are those in which successful cultures were carried out. Only such synonymy is given as will account for the names used at different times in the reports. The page numbers are those explained below at the beginning of the index. Pages in broad faced type indicate the host from which spores were taken for culture, while pages in common type indicate the host on which the culture was successfully established.

Year	Rust	Telial host	Aecial host
1904 1905	<i>Puc. Sorghi</i> Schw.	<i>Zea Mays</i> 59, 68	<i>Oxalis corniculata</i> (O. <i>cymosa</i> ) 59, 68
1909	<i>Puc. Ceanothi</i> (E. & K.) Arth.	<i>Andropogon Hallii</i> 168	<i>Ceanothus americana</i> 168
1912	<i>Puc. Ellisiana</i> Thüm.	<i>Andropogon</i> sp. 230	<i>Viola cucullata</i> 230 <i>V. Nuttallii</i> 230
1899 1903 1906 1910	<i>Puc. Andropogonis</i> Schw. ( <i>P. americana</i> Lagerh.)	<i>A. dropogon scoparius</i> 5, 6, 33, 87, 186 <i>A. virginicus</i> 186	<i>Penstemon hirsutus</i> ( <i>P.</i> <i>pubescens</i> ) 5, 6, 33, 87, 186 <i>P. alpinus</i> 186
1903 1905 1910	<i>Puc. pustulata</i> (Curt.) Arth.	<i>Andropogon furcatus</i> 39, 67, 186 <i>A. scoparius</i> 39	<i>Comandra umbellata</i> 39, 67, 186
1904 1905 1907	<i>Puc. Pammelii</i> (Trel.) Arth. ( <i>P. Panici</i> Diet.)	<i>Panicum virgatum</i> 50, 67, 105	<i>Euphorbia corollata</i> 50, 67 <i>E. marginata</i> 105
1901 1904 1905 1906 1907 1909 1910 1916	<i>Puc. poculiformis</i> (Jacq.) Wettst. ( <i>P.</i> <i>graminis</i> Pers.)	<i>Agropyron pseudorepens</i> 162 <i>A. repens</i> 51 <i>A. Smithii</i> 270 <i>A. tenerum</i> 51, 105, 187 <i>Agrostis alba</i> 68, 88, 187 <i>Avena sativa</i> 105 <i>Cinna arundinacea</i> 12 <i>Elymus canadensis</i> 51, 88, 270 <i>Hordeum vulgare</i> 88 <i>Sitanion longifolium</i> 162, 187 <i>Sporobolus cryptandrus</i> 270 <i>Triticum aestivum</i> ( <i>T.</i> <i>vulgare</i> ) 88, 162	<i>Berberis vulgaris</i> 12, 51, 68, 88, 105, 162, 187, 270
1917	<i>Puc. Majanthae</i> (Schum.) Arth.	<i>Phalaris arundinacea</i> 278	<i>Iris versicolor</i> 278
1904 1910 1912	<i>Puc. Stipae</i> Arth.	<i>Koeleria cristata</i> 189 <i>Stipa comata</i> 231 <i>S. spartea</i> 58, 188	<i>Aster ericoides</i> 58, 188 <i>A. multiflorus</i> 58, 188 <i>A. Novae-Angliae</i> 58, 188 <i>Grindelia squarrosa</i> 188 <i>Gutierrezia Sarothrae</i> 231 <i>Senecio spartioides</i> 189, 231 <i>Solidago canadensis</i> 188

Year	Rust	Telial host	Aecial host
1917	<i>Puc. Sporoboli</i> Arth.	<i>Sporobolus heterolepis</i> 280	<i>Allium cernuum</i> 280 <i>A. Nuttallii</i> 280 <i>Lilium umbellatum</i> 280
1899 1902 1904 1905	<i>Puc. verbenicola</i> (E. & K.) Arth. ( <i>P. Vilfae</i> Arth. & Holw.)	<i>Sporobolus longifolius</i> 7, 22, 50, 67	<i>Verbena stricta</i> 7, 22 <i>V. urticifolia</i> 22, 50, 67
1902 1904 1905 1906 1907 1908 1909 1910 1911 1915 1916 1917	<i>Puc. subnitens</i> Diet.	<i>Distichlis spicata</i> 25, 49, 68, 87, 104, 126, 160, 188, 208, 259, 273, 278	<i>Abronia fragrans</i> 273 <i>Atriplex hastata</i> 126, 160, 208 <i>Bursa Bursa-pastoris</i> 68, 104 <i>Chenopodium album</i> 25, 87, 104, 126, 160, 188, 208, 259, 278 <i>Cleome spinosa</i> 49, 208 <i>Erysimum asperum</i> 49, 68 <i>Lepidium densiflorum</i> ( <i>L. apetalum</i> ) 49 <i>L. virginicum</i> 49, 68 <i>Polygonum aviculare</i> 273 <i>Sarcobatus vermiculatus</i> 87, 126 <i>Sophia brachycarpa</i> 49, 68
1908 1909 1910 1914 1916	<i>Puc. Muhlenbergiae</i> Arth. & Holw. ( <i>P. tosta</i> Arth.)	<i>Muhlenbergia gracillima</i> 271 <i>M. mexicana</i> 142 <i>M. racemosa</i> ( <i>M. glomerata</i> ) 161, 187 <i>Schedonnardus paniculatus</i> 272 <i>Sporobolus asperifolius</i> 240, 241	<i>Callirhoe involucreata</i> 142, 161, 187 <i>Malvastrum coccineum</i> 271, 272 <i>Sphaeralcea digitata</i> 241 <i>S. incana</i> 240 <i>S. lobata</i> 241
1902 1903 1905 1907 1909 1910	<i>Puc. amphigena</i> Diet.	<i>Calamovilfa longifolia</i> 26, 33, 67, 104, 160, 187	<i>Smilax herbacea</i> 26 <i>S. hispida</i> 26, 33, 67, 104, 160, 187
1911 1912	<i>Puc. monoica</i> (Peck) Arth.	<i>Koeleria cristata</i> 234 <i>Trisetum majus</i> 213 <i>T. subspicatum</i> 213, 234	<i>Arabis</i> sp. 213, 234
1904 1910 1916	<i>Puc. Rhamni</i> (Pers.) Wettst. ( <i>P. coronata</i> Corda)	<i>Agrostis</i> sp. 271 <i>Avena sativa</i> 52 <i>Calamagrostis canadensis</i> 187	<i>Rhamnus alnifolia</i> 187 <i>R. caroliniana</i> 52 <i>R. cathartica</i> 52 <i>R. lanceolata</i> 52 <i>R. Purshiana</i> 271

Year	Rust	Telial host	Aecial host
1899 1904 1905 1907 1908 1909	<i>Puc. fraxinata</i> (Link) Arth. ( <i>P. peridermi- ospora</i> Arth.)	<i>Spartina Michauxiana</i> (not <i>S. cynosuroides</i> ) 8, 51, 67, 103, 160 <i>S. polystachya</i> 127 <i>S. stricta</i> 127	<i>Fraxinus lanceolata</i> (F. <i>viridis</i> ) 8, 51, 67, 103, 127, 160
1915 1916	<i>Puc. Distichlidis</i> E. & E. ( <i>P. Kelseyi</i> Syd.)	<i>Spartina Michauxiana</i> 261, 271	<i>Scirionema ciliatum</i> 261, 271
1905 1908 1910 1915	<i>Puc. Seymouriana</i> Arth.	<i>Spartina cynosuroides</i> 259 <i>S. Michauxiana</i> (not <i>S.</i> <i>cynosuroides</i> ) 75, 127, 188, 258	<i>Apocynum cannabinum</i> 258 <i>Asclepias syriaca</i> 259 <i>Cephalanthus occident- alis</i> 75, 127, 188
1902 1910	<i>Puc. Jamesiana</i> (Peck) Arth. ( <i>P. Bartholo- maei</i> Diet.)	<i>Bouteloua curtipendula</i> ( <i>Atheropogon curtii- pendulus</i> ) 24, 188	<i>Asclepias incarnata</i> 24 <i>A. syriaca</i> 24, 188
1899 1907 1909 1911	<i>Puc. Phragmitis</i> (Schum.) Körn.	<i>Phragmites communis</i> ( <i>P. Phragmites</i> ) 2, 104, 160, 208	<i>Rumex crispus</i> 2, 104, 160, 208 <i>R. obtusifolius</i> 2
1902 1907	<i>Puc. simillima</i> Arth.	<i>Phragmites communis</i> ( <i>P. Phragmites</i> ) 26, 104	<i>Anemone canadensis</i> 26, 104
1899 1902 1904 1915	<i>Puc. Windsoriae</i> Schw.	<i>Tridens flavus</i> ( <i>Triodia</i> <i>cuprea</i> , <i>Tricuspis ses- lerioides</i> ) 6, 22, 50, 260	<i>Ptelea trifoliata</i> 6, 22, 50, 260
1903	<i>Puc. Eatoniae</i> Arth.	<i>Eatonia pennsylvanica</i> 40	<i>Ranunculus abortivus</i> 40
1908	<i>Puc. Koeleriae</i> Arth.	<i>Koeleria cristata</i> 138	<i>Mahonia Aquifolium</i> 138
1916	<i>Puc. Liatridis</i> (E. & A.) Bethel	<i>Koeleria cristata</i> 273	<i>Lacinaria punctata</i> 273
1910	<i>Puc. Crandallii</i> Pam. & Hume	<i>Festuca confinis</i> 196	<i>Symphoricarpos race- mosus</i> 196
1915	<i>Puc. Cockerelliana</i> Bethel	<i>Festuca Thurberi</i> 256	<i>Thalictrum dioicum</i> 256
1908 1915	<i>Puc. Asperifolii</i> (Pers.) Wettst.	<i>Secale cereale</i> 128, 257	<i>Lycopsis arvensis</i> 128, 257
1915	<i>Puc. apocrypta</i> Ellis & Tracy	<i>Agropyron tenerum</i> 262 <i>Elymus virginicus</i> 262	<i>Hydrophyllum capi- tatum</i> 262

Year	Rust	Telial host	Aecial host
1904	<i>Puc. Clematidis</i> (DC.)	<i>Agropyron biflorum</i> 140	<i>Anemone cylindrica</i> 232
1906	Lagerh. ( <i>P. Agropyri</i> )	<i>A. pseudorepens</i> 105	<i>Aquilegia canadensis</i>
1907	E. & E., <i>P. tomitara</i>	<i>A. Smithii</i> 232	140, 161
1908	Trel., <i>P. cinerea</i> Arth.	<i>A. sp.</i> 161	<i>Clematis Drummondii</i>
1909	<i>P. alternans</i> Arth., <i>P. oblitterata</i> Arth.)	<i>Bromus purgans</i> 87, 127	242
1911		<i>B. ciliatus</i> 56	<i>C. ligusticifolia</i> 232
1912		<i>B. Porteri</i> 139	<i>C. virginiana</i> 55, 87, 105,
1914		<i>Elymus canadensis</i> 232	127
		<i>E. virginicus</i> 242	<i>Oxygraphis Cymbalaria</i>
		<i>Puccinellia airoides</i> 137, 208	( <i>Ranunculus Cymbalaria</i> ) 137, 208
			<i>Thalictrum alpinum</i> 161
			<i>T. dioicum</i> 139
			<i>Viorna Scottii</i> 105
1902	<i>Puc. Impatiensis</i>	<i>Elymus canadensis</i> 162	<i>Impatiens aurea</i> 25, 33,
1903	(Schw.) Arth.	<i>E. striatus</i> 161, 162	51, 161, 162
1904		<i>E. virginicus</i> 25, 33, 51,	
1909		162	
1907	<i>Puc. obtecta</i> Peck	<i>Scirpus americanus</i> 109	<i>Bidens cornata</i> 109
			<i>B. frondosa</i> 109
1890	<i>Puc. angustata</i> Peck	<i>Scirpus atrovirens</i> 6, 12,	<i>Lycopus americanus</i> 6,
1901		52, 86, 103, 186, 230	12, 52, 86, 103, 186,
1904		<i>S. cyperinus</i> 125, 208	208, 230
1906			<i>L. uniflorus</i> ( <i>L. communis</i> ) 125
1907			
1908			
1910			
1911			
1912			
1915	<i>Puc. Eriophori</i> Thülm.	<i>Eriophorum viridicarinatum</i> 255	<i>Senecio aureus</i> 255
1905	<i>Puc. canaliculata</i> (Schw.) Lagerh.	<i>Cyperus esculentus</i> 74	<i>Xanthium "canadense"</i> 74
1905	<i>Puc. Eleocharidis</i> Arth.	<i>Eleocharis palustris</i> 74, 87, 124	<i>Eupatorium perfoliatum</i> 74, 87, 124
1906			
1908			
1908	<i>Puc. macrospora</i> (Peck) Arth.	<i>Carex comosa</i> 134	<i>Smilax hispida</i> 134
1901	<i>Puc. Grossulariae</i> (Pers.) Lagerh. ( <i>P. albiperidita</i> Arth.)	<i>Carex arctata</i> 226, 254	<i>Ribes aureum</i> 53
1903		<i>C. blanda</i> 65, 86	<i>R. cynosbati</i> 12, 33, 53,
1904		<i>C. crinita</i> 53, 86, 102, 226	86, 102, 182, 225, 226,
1905			237, 254
1906		<i>C. flexuosa</i> ( <i>C. tenuis</i> ) 182, 226, 254	<i>R. gracile</i> 65, 86
1907		<i>C. gracillima</i> 33, 53	<i>R. rotundifolium</i> 53, 86
1910		<i>C. pallescens</i> 182	<i>R. uva-crispa</i> 33, 53
1912		<i>C. pubescens</i> 12, 225	
1913		<i>C. squarrosa</i> 86	
1915		<i>C. sp.</i> 237	



Year	Rust	Telial host	Aecial host
1901 1902 1905 1907 1909 1910	<i>Puc. Caricis</i> (Schum.) Schroet.	<i>Carex aristata</i> 158, 186 <i>C. nebraskensis</i> 66 <i>C. riparia</i> 22, 103 <i>C. stipata</i> 66, 103 <i>C. stricta</i> 11, 22, 186	<i>Urtica gracilis</i> 11, 22, 66, 103, 158, 186
1914	<i>Puc. minutissima</i> Arth.	<i>Carex filiformis</i> 245	<i>Decodon verticillatus</i> 245
1907 1909 1910 1916	<i>Puc. universalis</i> Arth.	<i>Carex filifolia</i> 270 <i>C. stenophylla</i> 110, 159, 185	<i>Artemisia dracuncu- loides</i> 110, 159, 185 <i>A. gnaphalodes</i> 270
1907	<i>Puc. Phrymae</i> (Halet.) Arth.	<i>Carex longirostris</i> 111	<i>Phryma leptostachya</i> 111
1901 1902 1904 1905 1907 1908 1909 1910 1912 1913 1914 1915	<i>Puc. Asterum</i> (Schw.) Kern ( <i>P. extensicola</i> Plow., <i>P. Curicis-Asteris</i> Arth., <i>P. Caricis-Erigerontis</i> Arth., <i>P. Caricis-Solidaginis</i> Arth., <i>P. Dulichii</i> Syd.)	<i>Carex festiva</i> 159, 185 <i>C. festucacea</i> 13, 22, 52 <i>C. foenea</i> 13, 14, 21 <i>C. Jamesii</i> 27 <i>C. retrorsa</i> 228 <i>C. rosea</i> 102 <i>C. scoparia</i> 184, 228, 229 <i>C. sparganioides</i> 66, 124 <i>C. stipata</i> 27 <i>C. sp.</i> 102 <i>C. vulpinoidea</i> 238, 240 <i>Dulichium arundinaceum</i> 240, 254	<i>Aster adscendens</i> 159, 185 <i>A. cordifolius</i> 14, 102 <i>A. paniculatus</i> 13, 14, 21, 102, 228 <i>Erigeron annuus</i> 13, 22, 52 <i>E. philadelphicus</i> 22 <i>Euthamia graminifolia</i> 184, 229 <i>Leptilon canadense</i> 22 <i>Solidago caesia</i> 27 <i>S. canadensis</i> 27, 66, 124, 238, 240, 254 <i>S. glaberrima</i> 238 <i>S. mollis</i> 238 <i>S. rigida</i> 27 <i>S. rugosa</i> 238 <i>S. serotina</i> 27 <i>S. ulmifolia</i> 27
1902 1904 1905 1906 1908 1909 1910 1911	<i>Puc. Peckii</i> (DeT.) Kellerm.	<i>Carex lanuginosa</i> 52, 66, 85, 158, 184, 208 <i>C. stipata</i> 20, 124 <i>C. trichocarpa</i> 20, 21, 52, 85, 158, 184	<i>Gaura biennis</i> 158 <i>Meriolix serrulata</i> 184 <i>Onagra biennis</i> ( <i>Oenothera biennis</i> ) 20, 21, 52, 66, 85, 124, 158, 184, 208
1906 1908 1910	<i>Puc. pratensis</i> Arth. ( <i>P. Opizii</i> Arth. not Bubák)	<i>Carex pratensis</i> 136 <i>C. siccata</i> 185 <i>C. sp.</i> 85	<i>Agoseris glauca</i> 136. <i>Lactuca canadensis</i> 85, 185 <i>L. sativa</i> 85, 185 <i>L. virosa</i> 85

Year	Rust	Telial host	Aecial host
1901 1902 1904 1905 1906 1908	<i>Puc. Sambuci</i> (Schw.) Arth. ( <i>P. Atkinsoniana</i> Diet., <i>P. Bolleyana</i> Sacc.)	<i>Carex Frankii</i> 85 <i>C. lupulina</i> 65 <i>C. lurida</i> 21, 124 <i>C. trichocarpa</i> 14, 21, 52	<i>Sambucus canadensis</i> 14, 21, 52, 65, 85, 124
1904 1905	<i>Puc. Polygoni-amphibii</i> Pers.	<i>Polygonum emersum</i> 53, 69, 53	<i>Geranium maculatum</i> 53, 69
1910	<i>Puc. argentata</i> (Schultz) Wint.	<i>Impatiens aurea</i> 189	<i>Adoxa Moschatellina</i> 189
1909	<i>Urom. Andropogonis</i> Tracy	<i>Andropogon virginicus</i> 163	<i>Viola cucullata</i> 163
1902 1917	<i>Urom. seditiosus</i> Kern ( <i>U. Aristidae</i> Auth. not E. & E.)	<i>Aristida basiramea</i> 279 <i>A. oligantha</i> 23	<i>Plantago aristata</i> 279 <i>P. lanceolata</i> 279 <i>P. Rugelii</i> 23
1916	<i>Urom. Sporoboli</i> E. & E.	<i>Sporobolus virginiae- florus</i> 274	<i>Allium stellatum</i> 274
1915	<i>Urom. Hordei</i> Tracy	<i>Hordeum pusillum</i> 263	<i>Nothoscordium striatum</i> 263
1911	<i>Urom. Peckianus</i> Farl.	<i>Distichlis spicata</i> 209	<i>Atriplex hastata</i> 209
1905 1907 1909 1910 1912 1917	<i>Urom. Polemonii</i> (Peck) Barth. ( <i>U. acuminatus</i> Arth., <i>U. Spartinae</i> Farl., <i>U. Steironematis</i> Arth., <i>U. magnatus</i> Arth.)	<i>Spartina Michauxiana</i> 76, 106, 164, 198, 236, 282	<i>Collomia linearis</i> : 236 <i>Polemonium reptans</i> 198 <i>Polygonatum biflorum</i> 282 <i>P. commutatum</i> 282 <i>Steironema ciliatum</i> 76, 106, 164 <i>S. lanceolatum</i> 164 <i>Vagnera stellata</i> 282
1906 1907 1908 1914	<i>Urom. Scirpi</i> (Cast.) Burr.	<i>Scirpus fluviatilis</i> 89, 106, 128, 242	<i>Cicuta maculata</i> 89, 106, 128 <i>Sium cicutaefolium</i> 242
1903 1910 1912 1914 1917	<i>Urom. perigynius</i> Halst. ( <i>U. Solidagini- Curicis</i> Arth.)	<i>Carex deflexa</i> 190 <i>C. intumescens</i> 190, 234 <i>C. sparganioides</i> 279 <i>C. tribuloides</i> 242 <i>C. varia</i> 37	<i>Aster ericoides</i> 190 <i>A. paniculatus</i> 190, 234 <i>A. Tweedyi</i> 242 <i>Rudbeckia laciniata</i> 279 <i>Solidago caesia</i> 37 <i>S. canadensis</i> 37, 234 <i>S. flexicaulis</i> 37 <i>S. serotina</i> 37 <i>S. rugosa</i> 190

Year	Rust	Telial host	Aecial host
1910 1912	<i>Urom. Junci</i> (Desm.) Tul.	<i>Juncus balticus</i> 191, 236	<i>Ambrosia artemisiaefolia</i> 191 <i>A. psilostachya</i> 191 <i>A. trifida</i> 191 <i>Carduus Flodmanii</i> 191, 236
1906 1907	<i>Urom. Silphii</i> (Syd.) Arth.	<i>Juncus tenuis</i> 92, 106	<i>Silphium perfoliatum</i> 92, 106
1908	<i>Urom. houstoniatus</i> (Schw.) Sheldon	<i>Sisyrinchium gramineum</i> 129	<i>Houstonia caerulea</i> 129
1908 1911	<i>Gym. Libocedri</i> (P. Henn.) Kern	<i>Libocedrus decurrens</i> 143, 211	<i>Amelanchier vulgaris</i> 211 <i>Crataegus cerronis</i> 211 <i>C. Pringlei</i> 143 <i>C. tomentosa</i> 211
1907 1911	<i>Gym. inconspicuum</i> Kern	<i>Juniperus utahensis</i> 113, 211	<i>Amelanchier erecta</i> 113 <i>A. vulgaris</i> 211
1909	<i>Gym. exiguum</i> Kern	<i>Juniperus virginiana</i> 169	<i>Crataegus Pringlei</i> 169
1908 1910	<i>Gym. Davisii</i> Kern	<i>Juniperus sibirica</i> 132, 194	<i>Aronia arbutifolia</i> 194 <i>A. nigra</i> 132, 194
1906 1907 1908 1910	<i>Gym. juvenescens</i> Kern	<i>Juniperus scopulorum</i> 93, 107, 130 <i>J. virginiana</i> 195	<i>Amelanchier canadensis</i> 93, 107 <i>A. erecta</i> 107, 130, 195 <i>A. intermedia</i> (A. Botryapium) 107 <i>Sorbus americana</i> 93, 107, 130
1911	<i>Gym. Kernianum</i> Bethel	<i>Juniperus utahensis</i> 216	<i>Amelanchier vulgaris</i> 216
1909	<i>Gym. trachysorum</i> Kern	<i>Juniperus virginiana</i> 172	<i>Crataegus cerronis</i> 172 <i>C. coccinea</i> 172 <i>C. punctata</i> 172
1908 1914	<i>Gym. Botryapites</i> (Schw.) Kern	<i>Chamaecyparis thyoides</i> 131, 242, 243	<i>Amelanchier canadensis</i> 242, 243 <i>A. intermedia</i> 131
1907 1909 1910 1911 1914	<i>Gym. nidus-avis</i> Thax.	<i>Juniperus virginiana</i> 108, 129, 165, 194, 210, 242	<i>Amelanchier erecta</i> 210 <i>A. vulgaris</i> 194, 242 <i>Crataegus Pringlei</i> 165 <i>Cydonia vulgaris</i> 194 <i>Malus coronaria</i> 129, 210 <i>M. Malus</i> 108, 129 <i>M. icensis</i> 165

Year	Rust	Telial host	Aecial host
1907 1908 1909 1910	<i>Gym. clavipes</i> C. & P.	<i>Juniperus sibirica</i> 107, 164, 193 <i>J. virginiana</i> 130	<i>Amelanchier erecta</i> 107, 164, 193 <i>A. intermedia</i> 107 <i>Crataegus punctata</i> 164 <i>C. tomentosa</i> 193 <i>C. sp.</i> 130
1908 1909 1910	<i>Gym. cornutum</i> (Pers.) Arth.	<i>Juniperus sibirica</i> 131, 165, 194	<i>Sorbus americana</i> 131, 165, 194 <i>S. aucuparia</i> 165
1908 1909	<i>Gym. exterum</i> Arth. & Kern	<i>Juniperus virginiana</i> 144, 166	<i>Porleranthus stipulatus</i> 144, 166
1911	<i>Gym. juniperinum</i> (L.) Mart. ( <i>G. tremel-</i> <i>loides</i> Hartig)	<i>Juniperus sibirica</i> 211	<i>Sorbus americana</i> 211
1911 1912	<i>Gym. gracilens</i> (Peck) Kern & Bethel	<i>Juniperus monosperma</i> 217 <i>J. utahensis</i> 237	<i>Philadelphus coronarius</i> 217, 237 <i>P. Keteleerii</i> 237
1911	<i>Gym. effusum</i> Kern	<i>Juniperus virginiana</i> 217	<i>Aronia arbutifolia</i> 217
1907 1908 1910 1911 1913	<i>Gym. clavariaeforme</i> (Jacq.) DC.	<i>Juniperus sibirica</i> 108, 130, 194, 210, 238	<i>Amelanchier erecta</i> 130, 194, 210 <i>A. intermedia</i> 108 <i>Crataegus cerronis</i> 238 <i>C. punctata</i> 194
1914	<i>Gym. Ellisii</i> (Berk.) Farl.	<i>Chamaecyparis thyoides</i> 246	<i>Myrica cerifera</i> 246
1907 1908 1909 1910 1912	<i>Gym. Betheli</i> Kern	<i>Juniperus scopulorum</i> 112, 113, 131, 165, 195, 237	<i>Crataegus cerronis</i> 165, 195 <i>C. coccinea</i> 112 <i>C. cordata</i> 113 <i>C. Pringlei</i> 237 <i>C. punctata</i> 112 <i>C. sp.</i> 131 <i>Sorbus americana</i> 112, 113, 131
1906 1907 1908 1909	<i>Gym. globosum</i> Farl.	<i>Juniperus virginiana</i> 90, 107, 130, 164	<i>Crataegus coccinea</i> 164 <i>C. Pringlei</i> 90, 130 <i>Malus coronaria</i> 90 <i>M. Malus</i> (Pyrus <i>Malus</i> ) 107 <i>Sorbus americana</i> 90
1911 1912	<i>Gym. Nelsoni</i> Arth.	<i>Juniperus scopulorum</i> 237 <i>J. utahensis</i> 215	<i>Amelanchier canadensis</i> 237 <i>A. vulgaris</i> 215

Year	Rust	Telial host	Aecial host
1909	<i>Gym. corniculans</i> Kern	<i>Juniperus horizontalis</i> 170	<i>Amelanchier canadensis</i> 170 <i>A. erecta</i> 170
1908 1909	<i>Gym. floriforme</i> Thax.	<i>Juniperus virginiana</i> 129, 166	<i>Crataegus coccinea</i> 166 <i>C. punctata</i> 129
1905 1906 1907 1908 1910	<i>Gym. Juniperi-virginianae</i> Schw.	<i>Juniperus virginiana</i> 64, 90, 106, 129, 193	<i>Malus coronaria</i> 90, 129 <i>M. Malus</i> (Pyrus <i>Malus</i> ) 64, 106, 129, 193
1905 1906	<i>Tranz. punctata</i> (Pers.) Arth. ( <i>Puc. Prunispinosae</i> Pers.)	<i>Prunus pumila</i> 89 <i>P. serotina</i> 71, 89	<i>Hepatica acutiloba</i> 71, 89
1903 1904 1905 1908	<i>Mel. Medusae</i> Thüm.	<i>Populus deltoides</i> 35, 46, 64 <i>P. tremuloides</i> 47, 133	<i>Larix decidua</i> 35, 46, 47, 64 <i>L. laricina</i> 46, 64, 133
1910 1911	<i>Mel. albertensis</i> Arth.	<i>Populus tremuloides</i> 198, 212	<i>Pseudotsuga mucronata</i> 198, 212
1904 1906	<i>Mel. Bigelowii</i> Thüm.	<i>Salix amygdaloides</i> 54 <i>Salix</i> sp. 84	<i>Larix decidua</i> 54, 84
1910	<i>Mel'sis abietina</i> (A. & S.) Arth.	<i>Ledum groenlandicum</i> 195	<i>Picea mariana</i> 195
1910	<i>Mel'ella elatina</i> (A. & S.) Arth.	<i>Cerastium oreophilum</i> 212	<i>Abies lasiocarpa</i> 212
1909	<i>Calyp. columnaris</i> (A. & S.) Körn.	<i>Vaccinium pennsylvanicum</i> 166	<i>Abies Fraseri</i> 166
1906 1910 1913	<i>Cron. Quercus</i> (Brond.) Schroet.	<i>Quercus Phellos</i> 238 <i>Q. rubra</i> 195, 238 <i>Q. velutina</i> 84	<i>Pinus virginiana</i> 84, 195 <i>P. taeda</i> 238
1910 1911 1913 1914	<i>Coleos. Vernoniae</i> B. & C.	<i>Vernonia crinita</i> 198 <i>V. fasciculata</i> 239, 243 <i>V. gigantea</i> 211	<i>Pinus pulustris</i> 239 <i>P. taeda</i> 198, 211, 239, 243

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Names in *italics* are synonyms.

Numbers in broad-faced type indicate successful cultures.

Numbers in square brackets refer to pages (1) where the common name is used for the species instead of the Latin name, or (2) where the name occurs but is not the species intended and not a synonym (*e.g.*, *Anchusa officinalis* for *Lycopsis arvensis*), or (3) where the name does not occur but some other name not a synonym (the error being due to wrong identification, *e.g.*, *Gymnosporangium Nelsoni* used for *G. juvenescens*, or to common but erroneous usage, *e.g.*, *Spartina cynosuroides* for *S. Michauxiana*).

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PURDUE UNIVERSITY.  
LAFAYETTE, INDIANA.

## NOTES AND BRIEF ARTICLES

*[Unsigned notes are by the editor]*

Professor F. S. Earle spent the summer months at his home in western Cuba, but expects to return to Porto Rico in September.

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Dr. H. E. Thomas has resigned his position at Cornell University to accept one with Professor Kern at Pennsylvania State College.

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Dr. F. J. Seaver accompanied Dr. Britton to Trinidad last February and returned with a splendid collection of fungi, in which the parasitic forms especially are well represented.

---

Mr. Rush P. Marshall, formerly Pathological Inspector, Office of Investigations in Forest Pathology, has been engaged to work on the potato wart disease for the Federal Horticultural Board.

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Dr. Alfred H. W. Povah has resigned as assistant professor of Forest Botany and Pathology in the New York State College of Forestry to accept the position of associate professor of Plant Pathology and associate pathologist at the Alabama Polytechnic Institute, Auburn, Alabama.

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Mr. Paul V. Siggers has accepted the position of Pathologist for the United Fruit Company and will be stationed at Changuinola, Panama, investigating diseases of the cocoanut palm and cacao. He was formerly Scientific Assistant for the Office of Investigations in Forest Pathology.

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Mr. E. J. Wortley has resigned his position as Director of Agriculture in Bermuda to accept a similar one in Nyasaland. Mr. E. A. McCallan, a native Bermudian and a graduate of the Ontario Agricultural College, succeeds him as Director at the Agricultural Station in Bermuda.

Professor A. de Jacewski, of the Institut de Mycologie at Petrograd, is on a visit to the United States after being cut off from the outside world about six years. He called at the Garden August 11, shortly after his arrival, and expects to spend two months in various parts of the country.

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JOHN MACOUN

Professor John Macoun, the distinguished Canadian naturalist, died July 18, 1920, at Sidney, British Columbia, at the advanced age of 89. He was born near Belfast, Ireland, and came to Canada in 1850 with his mother and two brothers. After preliminary scientific training in teaching, he was engaged for many years in botanical and zoological explorations in western Canada for the Canadian Government and at length became attached to the Geological and Natural History Survey. His scientific work covered a wide range, both in botany and zoology, and he was ably assisted by his son, the late James M. Macoun. Many of the plants collected by them are in the herbarium of the New York Botanical Garden.

W. A. MURRILL

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At the request of naturalists generally throughout Canada, the Ottawa Field-Naturalists' Club has decided to receive subscriptions for a permanent memorial in honor of the late Professor John Macoun, who died on July 18, 1920. Many of his friends have thought that the memorial should take the form of a painted portrait to be hung in the Victoria Memorial Museum. Such a memorial has now been decided upon and the painting will be made by Mr. Franklin Brownell, of Ottawa, the well-known portrait painter. The expenses in connection therewith will be about \$700. Subscriptions to this fund should be forwarded to Mr. Arthur Gibson, Dominion Entomologist, Ottawa, Canada.

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EDWARD T. HARPER

Dr. Edward T. Harper died at his home in Geneseo, Illinois, January 14, 1921. He was born at Sabula, Iowa, September 28,



1857; graduated from Oberlin College in 1881 and from the Chicago Theological Seminary in 1887; took a Ph.D. degree in Semitics at Leipzig in 1891; received the honorary degree of D.D. at Iowa College in 1902 and Oberlin in 1908; and for nineteen years, from 1892 to 1911, held the chair of Semitics and Comparative Religion at the Chicago Theological Seminary. From the time he retired because of ill health until shortly before his death, he was actively engaged in botanical studies, and had always been an ardent lover of plants. His botanical collections, which have been deposited in the Field Museum at Chicago, include a very full series of superb photographs and stereoscopic views of the fleshy fungi. Readers of MYCOLOGIA will remember an article on *Hypholoma* contributed by him in 1918; while his handsomely illustrated papers on *Pholiota*, *Stropharia*, and *Hypholoma*, published in the *Transactions of the Wisconsin Academy of Sciences*, 1912-1914, are well known to all students of the gill-fungi. Dr. Harper's sustained activity in mycology and his success in this field were due in part to the sympathetic interest and help of his brother, Robert A. Harper, Professor of Botany in Columbia University.

W. A. MURRILL

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A long list of Long Island fungi, prepared by Burnham and Latham, appeared as a "second supplementary list" in *Torreya* for January-February, 1921. Most of the species included belong to inconspicuous groups.

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"The Fungal Diseases of the Common Larch," by W. E. Hiley, contains over 200 pages, 23 plates, and 28 figures. The work includes a discussion of the various larch diseases, a summary of the relations of the larch to its diseases, and an extensive bibliography.

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Bacterial wilt of the castor bean forms the subject of a well-illustrated paper by E. F. Smith and G. H. Godfrey published in the *Journal of Agricultural Research* for May 16, 1921. Diseased plants were first received from Townsend, Georgia, where

the loss was sometimes as high as 30 per cent. The disease was later found at many points in Florida and elsewhere. The causal organism appeared to be *Bacterium solanacearum*, which attacks a number of different plants.

---

"A Handbook of British Lichens," by Annie Lorrain Smith, containing 158 pages of text and 90 text figures, has just been published by the British Museum. The object of the book is to supply a portable guide to the determination of lichens in the field. The 128 genera included are briefly described, while the species are distinguished by keys only. There is an introduction in which the morphology, ecology, etc., of lichens are discussed, and a glossary of the chief terms employed.

---

"Insects Injurious to Deciduous Shade Trees and Their Control," by Jacob Kotinsky, published as Farmers' Bulletin 1169 of the U. S. Department of Agriculture, is of interest to mycologists because of the close connection found to exist between insects and fungi when it comes to the treatment of diseases. In the gall-insects, which rarely affect the vitality of a tree, the connection between insect and host is exceedingly close. In one group the mother inserts an acid with the egg, but in all other groups it is the growth of the larva that provides the stimulus, the contact between the insect and the surrounding plant tissue being very intimate.

---

Last January I secured, near Greenville, South Carolina, several specimens which Dr. Burt, of the Missouri Botanical Garden, identified as *Tricholoma terreum*. One of the specimens which I kept in Greenville had been pierced by a pine needle. The other specimens kept well for a week or more, seeming to have the consistency of a *Russula*, but this pierced specimen rotted where the needle pierced it. Instead of the smell being objectionable it was sweet and would have made a good cologne odor. I do not know whether the fungus produced this odor from the pine needle or whether the needle caused the mushroom to give the odor. The needle was of the long variety peculiar, I believe, to the Piedmont section.—E. D. Hallock

On July 11 Mrs. John R. Delafield sent to the Garden, from her lawn in Riverdale, an unusually large specimen of *Grifola gigantea*, a polypore that grows in tufted form from buried roots, stumps, and about the base of trees, the mycelium being parasitic on the roots of oak and other deciduous trees in this region. This particular specimen measured two feet across and one foot in height and developed from a stump which had been cut off close to the ground. It was nearly white when young and fresh, becoming grayish on developing and smoky-blackish on drying. Another large fungus, *Grifola Berkeleyi*, similar in shape to *G. gigantea*, occurs about oak trees in the eastern United States, but may readily be distinguished by its creamy color and the lack of blackish tints on drying.

---

Spike disease of sandalwood in India has been discussed by several investigators in recent years. Some believe that it is caused by ultra-microscopic organisms, and perhaps disseminated by insects, while its spread from centers favors the infection theory. Experiments at Komattiyur and Andiappanur gave results entirely opposed to the theory that spike is caused by an unbalanced circulation of sap. Transmission of infection over the long distances observed has not been explained, however. Birds, insects, or flying foxes may act as carriers, but carriage through other plants is considered more probable. Spike develops more rapidly in some areas than in others, and is more rapid in seedlings and saplings than in older trees. May to July is the most favorable portion of the year for its extension. Spike does not progress regularly from branch to branch. The preventive measures proposed include mainly isolation and destruction of the trees infected.

---

The North American species of *Stereum* were discussed by E. A. Burt in the *Annals of the Missouri Botanical Garden* issued in December, 1920. Seventy-seven species are recognized in this difficult genus, while several are imperfectly known and many now belong in *Aleurodiscus*, *Thelephora*, etc. The main divisions of the genus are based on the presence or absence, or

attachment of the stipe, but these differences are not considered sufficient to divide the genus. Five thickly crowded half-tone plates add greatly to the value of this excellent paper of 160 pages of text and 48 text figures.

Species described as new in this paper are as follows: *Stereum caespitosum*, Jamaica, Murrill; *S. saxitas*, Mexico, Murrill—also Jamaica, Johnson; *S. pubescens*, Montana, Mrs. Fitch; *S. conicum*, Cuba, Wright; *S. patelliforme*, Washington, Suksdorf—also California and New Mexico; *S. Earlei*, Jamaica, Earle; *S. magnisporum*, Jamaica, Murrill; *S. spumecum*, New York, Burnham—also Pennsylvania, South Carolina, Louisiana, and Mexico; *S. crumpens*, District of Columbia, Shear—and known to occur from Rhode Island to Alabama and west to Washington and Oregon; *S. sepium*, Georgia, Humphrey—and known to occur from Pennsylvania to Mexico and Colombia; *S. heterosporum*, Mexico, Matthews—and known on the Pacific coast as far northward as Oregon; and *S. durum*, Mexico, C. L. Smith.

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In Bulletin 933 of the U. S. Department of Agriculture, on Black Walnut, by F. S. Baker, the following statement is made regarding the diseases caused by fungi:

Black walnut is moderately free from tree diseases and is as resistant to injury as any of its associates. Red butt rot is found in a small percentage of trees, mostly old trees of northern growth, although it is very bad in parts of central Kentucky. As a rule the rot extends only a short distance up the tree, and "butting off" the lower 3 or 4 feet of a hollow tree will usually remove most of this defect. The "doty" zone that surrounds the advanced decomposition at the center is generally narrow; it is frequently possible, in fact, to saw boards within an inch of an open hollow before any discoloration appears.

A white top rot is found, limited almost entirely to southern logs, particularly from Oklahoma and Texas. Its presence is indicated by punky knots and occasionally by conks on the upper trunk. This rot extends a greater distance up and down the trunk than the red butt rot and is a much greater detriment to

the logs, especially if they are to be used for sawing into lumber. A large log with a defective center might be made to furnish a large amount of first-class veneer, but could not to advantage be sawed into lumber.

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The relation of the health of the host and other factors to infection of *Apium graveolens* by *Septoria Apii* is discussed at length by H. E. Thomas in the *Torrey Bulletin* for January, 1921. According to the author, "students of immunity and susceptibility have been slow to recognize any fundamental distinctions in the relations of host and parasite in the great group of organisms which cause disease in plants and animals, and yet the concepts of saprophyte, semi-saprophyte, and obligate parasite have been current at least since the time of DeBary. Under the influence perhaps chiefly of Ehrlich's side chain theory of immunity, degrees of resistance have been regarded on the one hand as inversely parallel to the virulence of the attacking organism, and on the other hand as directly parallel to the vigor of the host. In plant pathology this view has been particularly prominent in the literature of the facultative parasites. With the development of the science of immunity, the animal pathologist has gone so far as to regard the interactions of host and parasite as specific in each case. It is becoming increasingly apparent that the specificity in the relation of plant pathogens with their hosts must be reckoned with. The saprophytic fungus may be able to live on dead tissue from a wide range of plants, sometimes showing little preference for any one of them. The semi-saprophyte may or may not be more limited in its food range on dead material and attacks from one to a considerable number of living plants with varying degrees of virulence and with variable results to the hosts. The obligate parasite is usually still more restricted in its host range and is much more closely adapted to the living host, having completely lost the ability to grow on dead tissue, even that of its most common host. In the more highly specialized forms the relation may become specific to such a degree that a comparatively slight change in either host or fungus will completely change the virulence of the parasite or the effect on the

host. It is to be expected, after the long period of association necessary for the close adaptation of fungus to host, that both would be more or less similarly influenced by their environmental conditions. I shall present data to show that the infection of *Apium graveolens* by *Septoria Apii* is favored by conditions which accelerate the growth of the host. The comparatively narrow specialization of the *Septoria* on celery suggests a promising outlook for experiments in breeding for resistance. More intensive work in this direction is needed."

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IS AMANITA PANTHERINA EDIBLE OR POISONOUS?

It will interest mycologists to note that Dr. Raebiger<sup>1</sup> has experimented toxicologically with *Amanita pantherina*, a species usually regarded with fear. Raebiger fed the plant raw to guinea pigs, while rabbits were given material, in part raw, in part cooked. Two goats and two pigs were supplied with daily rations of ten German pounds of parboiled material for a period of six weeks. In the case of the pigs, other poisonous and suspicious species were included in the rations. In none of these animals was it possible to observe any impairment of their health.

The author states further that he has for years gathered this species for his own consumption without experiencing the slightest poisonous effects. He admitted no other species into his messes of *A. pantherina*, and, before cooking, would remove the cuticle of the pileus, the "cortex" of the stem, and then parboil, throwing away the water.

We know that edibility for this species, after preliminary precautions such as Dr. Raebiger took, has been claimed by Michael,<sup>2</sup> who says that it is excellent, cooked, or as a pickle. Ford<sup>3</sup> regards it as mildly poisonous. Inoko<sup>4</sup> and Boehm<sup>5</sup> have made

<sup>1</sup> Raebiger, Dr., Zur Kenntnis der Gift und Nutzpflanze. Berliner klin. Wochenschrift, No. 38. 1919.

<sup>2</sup> Michael, E., Fuchrer fuer Pilzfreunde. Ausgabe 'B,' Gruppe 76. 1918.

<sup>3</sup> Ford, W. W., The Distribution of Poisons in the Amanitas. Jour. of Pharm. and Exper. Therap., Vol. I, No. 2, p. 277. Aug. 1909; and, A Clinical Study of Mushroom Intoxication. The Johns Hopkins Bull., XVIII, No. 193, pp. 124 (14) and 129 (20). April, 1907.

<sup>4</sup> Inoko, Y., Ueber die giftigen Bestandtheile und Wirkungen des Japan-

rather exhaustive chemico-toxicological examinations. *Amanita pantherinoides* Murrill, a related species, "was eaten by two persons with almost fatal results."<sup>6</sup>

\*With several European forms, a Japanese form, with our own more or less closely allied species (*A. cothurnata* Atk., *A. velatipes* Atk., and *A. pantherinoides* Murrill), and with the umbrinous form of *A. muscaria* entering into the complex all too frequently called "*A. pantherina*," it would appear that results, in a toxicological examination of this "species," are likely to prove inconclusive unless considerable systematic acumen is permitted to supervene.

L. C. C. KRIEGER

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<sup>5</sup> Boehm, R., Beitræge zur Kenntniss der Hutzpilze in Chemischer und toxicologischer Beziehung . . . II. *Amanita pantherina*. Archiv fuer. exper. Pathol. u. Pharmac. v. Naunyn u. Schmiedeberg, XIX. 1885, p. 60; see also Berichte d. Deutsch. Chem. Gesell., XIX. 1886. Refer. p. 34.

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